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*ANNUAL REPORT*

*of the COMMISSIONER*

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*to the*

*SECRETARY OF THE INTERIOR*

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*For the Fiscal Year Ended June 30, 1949*

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*Fiscal Year Ended June 30*

**1949**





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# Bureau of Reclamation

Michael W. Straus, *Commissioner*



## DESIGN AND CONSTRUCTION

AN ALL-TIME RECORD construction program for development of irrigable lands and expansion of hydroelectric facilities on projects throughout 17 Western States was accomplished by the Bureau of Reclamation during fiscal year 1949. This program, representing a widely diversified undertaking of design and construction of dams, canals, power plants, pumping plants, transmission lines, and other important features intrinsic in the Bureau's projects, was by far the largest in Bureau history. Embracing an expenditure of almost 250 million dollars, the 1949 program was more than 40 percent greater than the 1948 program.

Included in the 1949 program was the continued expansion of construction on the largest of the Bureau's basin-wide developments, the Missouri River Basin project; the start of major construction activity at Hungry Horse Dam, largest concrete dam now being built; and the continuance of construction of important irrigation and power features on the Columbia Basin, Central Valley, Colorado-Big Thompson, and other projects.

A significant development during the year was the leveling-off of construction costs and increased rate of accomplishment by contractors' forces. Notable also was the general willingness of contractors to submit more competitive bids.

Noteworthy progress in research on materials of construction during the last year indicated substantial savings could be realized on structures which are now under construction and on those which are to be undertaken in the future. These savings are accomplished by improved use of construction materials and new methods of construction.

### *Contract Awards*

Major contracts awarded during the year included construction of Canyon Ferry Dam in Montana, Cedar Bluff Dam in Kansas, and Bonny Dam in Colorado. The largest award of the year was made for

the completion of the Grand Coulee pumping plant and miscellaneous construction work at Grand Coulee Dam in Washington.

The total value of the more than 800 construction, material, equipment, and supply contracts awarded during fiscal year 1949 amounted to about 163 million dollars. Of the total contract amount, construction contracts accounted for 139 million dollars or about 85 percent. By comparison, construction contracts awarded during the previous year amounted to approximately 105 million dollars. A summary of the major contracts awarded during fiscal year 1949 is given in table 1.

TABLE 1.—*Major Bureau of Reclamation contracts awarded in fiscal year 1949*

Feature	Project	Amount of award
Completion of Grand Coulee pumping plant and miscellaneous construction work at Grand Coulee Dam.	Columbia Basin.....	\$13,348,419
Canyon Ferry Dam and power plant.....	Missouri River Basin.....	11,896,425
Cedar Bluff Dam.....	do.....	11,350,735
Booby Dam.....	do.....	10,301,653
16 miles East Low Canal and 6 miles Rocky Coulee Wasteway.	Columbia Basin.....	8,029,762
2.5 miles Soap Lake siphon.....	do.....	7,614,728
27 miles Friant-Kern Canal.....	Central Valley.....	7,494,372
17 miles West Canal.....	Columbia Basin.....	6,136,234
Generators for units R-7, R-8, and R-9 at Grand Coulee Dam.	do.....	5,250,034
Shadehill Dam.....	Missouri River Basin.....	5,116,796
North Coulee Dam and 2 miles feeder canal.....	Columbia Basin.....	4,718,725
15.6 miles Delta-Mendota Canal.....	Central Valley.....	4,165,764
14.8 miles Delta-Mendota Canal.....	do.....	3,679,107
Platoro Dam.....	San Luis Valley.....	2,727,792
Turbines for units R-7, R-8, and R-9 at Grand Coulee Dam.	Columbia Basin.....	2,497,950
5.5 miles Salt Lake Aqueduct.....	Provo River.....	2,429,201
7 miles Horsetooth Feeder Canal.....	Colorado-Big Thompson.....	2,369,654
Turbines for units A-3, A-4 for Hoover power plant.	Boulder Canyon.....	2,080,100
Unit 6, Coachella Valley distribution system.....	All-American Canal system.....	2,049,922

### *Construction Progress*

At the end of the year, construction was in progress on 23 storage dams and 1 diversion dam, 9 power plants, 22 pumping plants, 440 miles of main canals, and 1,600 miles of transmission lines.

The rate of construction progress on many projects was greater than had been anticipated. For example, the construction of Jackson Gulch Dam on the Mancos project in Colorado was scheduled for completion by April 1950 but was actually completed in December 1948. By the end of the fiscal year, construction on O'Sullivan Dam on the Columbia Basin project was virtually completed with only 62 percent of the contract time elapsed; thus completion was approximately 18 months earlier than was required by the contract.

A significant increased rate of accomplishment on Bureau of Reclamation projects was made during the year. Notable was the increased rate of progress of placement of earth fill in dams, excavation for large canals, and lining of canals. The trend toward acceleration in monthly placement quantities in earth-fill dams was particularly



outstanding. This increase in placement quantities was attributed to three major factors: more efficient use of older types of earth excavating and transporting equipment, production of larger capacity models of such equipment, and development of new machines and procedures. The high rate of accomplishment on Bureau projects has required revisions in payment schedules on some projects. As a result, supplemental funds were needed to continue the rapid pace of construction.

During the year, the main embankment of Davis Dam was completed. What is believed to be a record for earth placing operations on a Bureau project was established at this dam during February 1949 with the placement of 770,000 cubic yards of material in the 3,500,000-cubic-yard embankment.

Excavation work continued on Hungry Horse Dam, largest of Bureau dams under construction. Installation of equipment for handling aggregate and concrete was in progress to facilitate initial placement of concrete by the fall of 1949. Work on the principal contract for the construction of Boysen Dam and power plant was about 60 percent complete by the end of the fiscal year as compared with 43 percent of the contract time elapsed.

### *Principal Features Completed*

Principal features completed on Bureau projects this year are shown in table 2.

TABLE 2.—*Principal features completed on Bureau of Reclamation projects in fiscal year 1949*

Feature	Project	State
Jackson Gulch Dam.....	Mancos.....	Colorado.
Cascade Dam.....	Boise.....	Idaho.
Long Lake Dam.....	Columbia Basin.....	Washington.
Olympus Dam.....	Colorado-Big Thompson.....	Colorado.
Horsetooth Reservoir Dams.....	do.....	Do.
Cambridge diversion dam.....	Missouri River Basin.....	Nebraska.
Heart Mountain power plant.....	Shoshone.....	Wyoming.
Aspen Creek siphon.....	Colorado-Big Thompson.....	Colorado.
Prospect Mountain conduit.....	do.....	Do.
Phoenix-Tucson No. 2 transmission line.....	Davis Dam.....	Arizona-Nevada.

### *Continuing Program*

The structures tabulated in table 3 are among the major features expected to be placed under construction on Bureau of Reclamation projects during fiscal year 1950. Major features of Bureau projects expected to be completed in fiscal year 1950 are indicated in table 4. Approximately 560 miles of transmission lines and over 150 miles of canals now under construction are expected to be completed during fiscal year 1950.

TABLE 3.—Major features expected to be placed under construction on Bureau of Reclamation projects in fiscal year 1950

Missouri River Basin project:	Santa Barbara project:
Keyhole Dam, S. Dak.	Cachuma Dam, Calif.
Anchor Dam, Wyo.	Tecolote Tunnel, Calif.
Tiber Dam, Mont.	South coast irrigation and water supply conduit, California.
Missouri Diversion Dam, Mont.	Columbia Basin project:
Trenton Dam, Nebr.	East Low Canal, Wash.
Narrows Dam, Colo.	Potholes East Canal, Wash.
Red Willow Diversion Dam, Nebr.	West Canal, Wash.
Cambridge Canal, Nebr.	Laterals to serve 87,000 acres, Washington.
Courtland Canal, Nebr.	Provo River project:
Boysen-Alcova transmission line, Wyoming.	Murdock Diversion Dam, Utah.
Thermopolis-Lovell transmission line, Wyoming.	Duchesne Diversion Dam and Duchesne Tunnel, Utah.
Havre-Shelby transmission line, Montana.	Riverton project:
Colorado-Big Thompson project:	Muddy Ridge Canal, Wyo.
Carter Lake Dam, Colo.	Paonia project:
North Poudre Diversion Dam, Colo.	Fire Mountain Canal, Colo.
Pole Hill and Olympus Tunnels, Colo.	Gila project:
Carter Lake Pressure Tunnel, Colo.	Pumping plants 1, 2, and 3, Wellton-Mohawk Canal, Ariz.
Willow Creek Canal, Colo.	Davis Dam project:
North Poudre Supply Canal, Colo.	Davis Dam, Prescott-Mesa and Mesa-Coolidge transmission lines, Arizona-Nevada.
St. Vrain Supply Canal, Colo.	Davis Dam-Hoover Dam, and Davis Dam-Parker Dam transmission lines, Arizona-Nevada.
Colorado-Big Thompson transmission lines, Colorado.	
Central Valley project:	
West side transmission lines, California.	

TABLE 4.—Major features on Bureau of Reclamation projects expected to be completed in fiscal year 1950

Feature	Project	State
Enders Dam.....	Missouri River Basin.....	Nebraska.
Medicine Creek Dam.....	do.....	Do.
Angostura Dam.....	do.....	South Dakota.
Gering-Sidney transmission line.....	do.....	Nebraska.
Gering-Alliance transmission line.....	do.....	Do.
Williston-Garrison Dam transmission line.....	do.....	North Dakota.
Granby Dam.....	Colorado-Big Thompson.....	Colorado.
South Coulee Dam.....	Columbia Basin.....	Washington.
Rehabilitation of Pathfinder Dam.....	North Platte.....	Wyoming.
Keswick power plant.....	Central Valley.....	California.
Second Parker-Gila transmission line.....	Davis Dam.....	Arizona-Nevada.
Fort Peck-Williston transmission line.....	Fort Peck.....	North Dakota.
Canals, laterals, drainage.....	Tucumcari.....	New Mexico.

### Cost Trends

Costs of both material and labor, which have shown a continuous increase since 1940, appear to have reached a peak during the last half of 1948. Bureau of Reclamation construction cost indexes in most categories, as illustrated in table 5, indicate a slight decline in costs of the principal types of Reclamation work for the period ending June 30, 1949. It will be noted, however, that one type of work actually increased while four others remained the same as in January 1949. An

TABLE 5.—*Bureau of Reclamation construction cost indexes—fiscal year 1949*

Cost indexes based on January 1940 costs=1.00	July 1948	January 1949	June 1949
Dams:			
Earth.....	2.15	2.25	2.15
Concrete.....	2.00	2.10	2.15
Pumping plants:			
Building.....	2.35	2.45	2.30
Equipment.....	1.80	1.80	1.75
Discharge pipes.....	2.25	2.40	2.10
Canals and conduits:			
Canals.....	2.30	2.35	2.30
Conduits.....	2.20	2.30	2.30
Laterals and drains.....	2.45	2.45	2.45
Powerplants, hydro:			
Building.....	2.30	2.40	2.30
Equipment.....	1.75	1.75	1.75
Penstocks.....	2.25	2.40	2.10
Transmission switchyards and substations.....	1.80	1.80	1.75
Transmission lines (wood pole).....	2.50	2.40	2.35
Roads and bridges:			
Primary roads, surfaced.....	2.10	2.20	2.20
Secondary roads, unsurfaced.....	2.20	2.25	2.15
Bridges.....	2.20	2.30	2.25
Composite index.....	2.15	2.20	2.20

easing in the tightness of the supply of materials accompanied by a decline in the cost of some materials and a noticeable increase in labor efficiency and in the number of bidders on Reclamation work were evident during the year. These factors were offset, however, by increases in labor rates as a result of certain classes of labor receiving wage increases and in the readjustment of minimum wage rates. As a result, there was a leveling-off of construction costs rather than a sharp decline.

During the year a definite increase was noted in the number of bidders on most Bureau work. This has resulted in some instances in lower bids being received. Also noted was the smaller spread between the high and low bids, indicating that contractors were computing their estimates more closely. For example, bid openings for construction of transmission lines covering identical work previously advertised showed not only a large increase in the number of bidders but also bids from 4 to 30 percent lower than those received during the preceding year. While this reflects to a large extent the availability of transmission-line materials, it also indicates in general a willingness on the part of contractors to submit really competitive bids. Contractors are now more willing to accept contracts without including in their bids large contingency items to cover every possible expenditure.

### *Force Account*

The amount of force-account work performed by the Bureau was within legislative limitations and represented a negligible proportion of the total construction work accomplished during the fiscal year. However, minor construction activities by means of force-account work

were carried out on some projects. These activities ranged from operation of a sawmill at Keswick Dam to installation of electrical equipment on various projects after the major construction was completed.

### *Standard Specifications*

This year the Branch of Design and Construction initiated the use of standard specifications for construction of canal systems which has as its objective the elimination of duplicate material and the expediting and review of specifications of structures of similar nature. Specifications for canals, laterals, and similar structures were published and issued under this plan. Also, a volume of standard specifications and drawings for H-frame, wood-pole transmission lines was prepared and used during the year.

As an example of measures taken to attract more and possibly lower bids, the readvertisement for Canyon Ferry Dam and power plant contained a provision allowing the contractor to obtain monthly payment for 85 percent of his investment in special concrete plant and equipment. The payments to the contractor were to be repaid to the Government by deductions from the contractor's earnings at a specified rate per cubic yard of concrete placed in the dam.

In construction specifications, provisions were included, when practicable, to provide for the contractor to prepare reinforcement-bar detail drawings. This method was inaugurated in the specifications for the construction of pipe lines on unit 6 of the Coachella Valley distribution system.

A procedure for supplying duplicate bidding schedules to bidders on both supply and construction specifications was inaugurated. By use of this procedure, the bidder can retain a copy of the specifications for his records and submit his bid on the duplicate bidding schedule and accompanying forms.

Four hundred and thirty specifications for both construction and long-form supply contracts were reviewed and issued by the Branch of Design and Construction this year.

### *Staff Development Program*

A staff development program inaugurated this year by the Branch of Design and Construction aimed at providing new employees broader knowledge of the Bureau's activities and giving young engineers an opportunity to obtain diversified experience in the various design, research, and construction functions of the branch. New employees rotate from one assignment to another, receiving valuable training under the guidance of experienced Bureau engineers. Participants remain in this program for approximately 2 years, gaining at least



6 months of design experience, 3 months of research experience, and 3 months of field experience during the first year. During the second year of the program, the participants are given an opportunity to specialize in the field of work for which they are best qualified. Concurrently with the work experience program, supplementary instruction is given by technical specialists in the Branch of Design and Construction.

To assure the satisfactory service condition and functioning of Bureau of Reclamation structures and facilities at all times, a program of inspection and preparation of operators' instructions was initiated. Principal objectives of the program are the verification of the safety of the works or disclosure of unsafe conditions; verification of the adequacy of the works in their current condition to meet operating requirements; and the utilization of the service experience for the improvement of design and construction practices.

Engineers in the Branch of Design and Construction participated in many activities of professional engineering societies, including the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Society for Testing Materials, the American Institute of Electrical Engineers, the American Concrete Institute, and the Geological Society of America. Besides serving as members on important committees of these societies, the engineers presented over 35 technical papers at various meetings of the societies.

Bureau engineers actively participated also in the affairs of several international professional organizations. Technical papers by these engineers were prepared for such organizations as the International Assembly of Scientific Hydrology and Geophysics, the Pan American Engineering Congress, and the International Conference on Large Electric High Tension Systems.

### *Research*

Research, geologic investigations, and testing activities of the Denver research laboratories were intensified as many new features of Bureau projects entered design and construction phases. Major activities in the laboratories included the testing of construction materials, such as cement, aggregate, soils, and protective coatings of metalwork, the verification of design through the use of structural and hydraulic models, and the appraisal of foundation conditions and structure sites. Noteworthy progress was made in the fields of special experimentation wherein new techniques and procedures could be utilized in the solution of future research problems.

Hydraulic studies were completed on the determination of the location of the Delta Cross Channel which is to effect the transfer of water from the Sacramento River to the San Joaquin River on the



Central Valley project. Investigations advanced materially in the measurement and prevention of water seepage from canals. Research directed toward the development of more effective and cheaper canal linings culminated in several test installations of buried asphalt membrane and in the development of rapid and inexpensive placement of concrete linings by the use of relatively simple equipment.

Research toward the continued improvement of the protection of metal linings of pipes and conduits was exemplified by the application of 24 test sections of various protective coatings to the penstocks of Shasta Dam. The first Bureau installation using cathodic protection, an electrical method for preventing corrosion on metalwork, was made on two steel water tanks on the Boulder Canyon project.

Research in control of weeds in canals was noteworthy for the development of a new "slug treatment" by which large quantities of weed killer could be applied for a short period to water in the weed-infested canals. Investigations were made for the control of algae infestations of hydraulic works, and tests were performed on the effect of weed killers upon crop growth.

The method devised in the Denver laboratories for measurement of residual stresses in rocks exposed in tunnels and excavations was further developed. Studies made on the pressure of ice on dams and other structures led to increased knowledge that will be of great usefulness in the design and construction of future projects.

Studies of cavitation and protection measures for the avoidance of this damaging effect upon hydraulic structures were continued. Experimentation was directed also toward improved design of reinforced concrete and the better utilization of new types of reinforcement steel. Investigations of the physical properties of loess soils and their possible utilization as foundation and construction materials on structures in the Missouri River Basin were undertaken. Studies were made also on the design of satisfactory concrete mixes that include the inferior aggregates of the Kansas-Nebraska region.

Notable new developments in geological and related studies were made through the application of geophysical techniques in the study of foundations and construction materials available at construction sites. Research was carried out on ground-water investigations, and studies were made of the permeability of rocks and soils as well as of the effect of expansive pressures exerted on structures by certain types of foundation clays.

The effectiveness of the research and testing facilities of the laboratories was greatly enhanced during the year by the installation of special equipment, including a flame photometer for use in the chemical analysis of engineering materials, X-ray diffraction apparatus for quicker and more detailed study of soils, minerals, and other substances, and equipment for the identification of materials by the

method of differential thermal analysis. Installation of a new 5-million-pound testing machine was begun. This huge machine, when installed, will permit more extensive experimentation and research on large specimens and structure models than was previously possible.

An important research accomplishment was the culmination of studies on the use of pozzolanic materials in concrete structures. Although these studies have not been completed, they have progressed sufficiently to indicate that about 30 percent of the cement in the concrete for Hungry Horse Dam could be replaced by fly-ash (an inexpensive waste product of coal-burning boilers). Not only will an improved concrete result through the use of this material, but substantial savings will be realized on this dam and similar concrete structures to be undertaken in the future.

### *Work Performed for Other Agencies*

As a result of its preeminence in the field of design and construction of structures of unprecedented size and complexity, the Bureau has been called upon for assistance from outside agencies and other Government departments. By agreement with the International Boundary and Water Commission, the Bureau engaged in the preparation of detailed designs and specifications for the Falcon Dam which is to be built by the Commission on the Rio Grande River about 60 miles downstream from Laredo, Tex., as provided by the Water Treaty of 1944 between the United States and Mexico. During the year, alternate preliminary designs and estimates were prepared and presented at a joint conference in Denver, from which a final design scheme was selected. Following selection of final design of the dam, rapid progress was made in preparation of detail designs and specifications to arrive at allocable costs, and a design feature report was furnished to the Boundary and Water Commission. Bureau engineers attended several conferences with the United States section of the Commission, and three joint conferences were convened to implement the work so that the completion of construction as provided by the treaty could be accomplished by 1953.

Under a contract with the city of Seattle, Wash., the Bureau's Denver laboratories conducted tests on the determination of creep factors in mass concrete specimens from Ross Dam. In connection with this work, field data on temperature, stress, and strain measurements of the mass concrete in the dam were obtained.

Other work performed in the laboratories for outside agencies included concrete investigations for the Corps of Engineers, lightweight concrete tests for the Housing and Home Finance Agency, aggregate and concrete durability tests for the Atomic Energy Commission, aggregate and riprap studies and geologic investigations for the

Bureau of Indian Affairs, tests of wood preservative for the Forest Service, aggregate and concrete durability studies for the Puerto Rico Water Resources Authority, aggregate studies for the Tennessee Valley Authority, and concrete studies and hydraulic model testing for the Salt River Valley Water Users Association. A cooperative program of investigations of lightweight concrete, performed in conjunction with the Housing and Home Finance Agency, was brought to a successful conclusion.

During the year Bureau of Reclamation mapping activities and particularly those using aerial photography were coordinated with the programs of such primary mapping agencies as the Geological Survey to insure that no duplication occurred. Other agencies included the Army Map Service, Coast and Geodetic Survey, and Soil Conservation Service. Contracts for aerial photography and mapping were awarded by the Bureau for areas in California, Montana, New Mexico, Texas, and Utah, where urgent requirements could not be met by the primary mapping agencies.

Coordinative seismological studies with the United States Coast and Geodetic Survey and the National Park Service at Hoover, Shasta, and Hungry Horse Dams were continued and expanded during the year to meet requirements of the Bureau and the Coast and Geodetic Survey.

Twenty new inventions were reported by employees of the Bureau of Reclamation, and patents were granted on three devices which were previously reported.

### *International Cooperation*

Technical assistance to foreign countries given by the Bureau of Reclamation in the various fields of water resources use and development including irrigation, hydroelectric power, drainage, and comprehensive basin development was furnished in four general categories.

Under authority of Public Law 402, Eightieth Congress, in-service training was given to 53 young engineers from seven foreign countries, the period of training averaging approximately one year. These were all class B grants (Public Law 402), each handled individually with costs being borne by the countries concerned.

In response to specific requests or in accordance with established exchange arrangements, approximately 2,000 items of technical data and publications pertaining to Bureau methods and practice were distributed to individuals and agencies of foreign governments.

The Bureau furnished advice and consultation to some 600 engineers, professors, and responsible officials from 56 foreign countries in matters related to development of water resources. Visits by these people



varied in length from a day or two to several weeks. Advice and consultation were given in respect to specific projects in some cases and in regard to a wide range of subjects in others. Requests for these visits were received through the Department of State and assistance was given under provisions of Public Law 402. Where detailed advice and consultation were given, costs were borne by the country concerned.

Typical of the many requests for Bureau engineering assistance on foreign work was the request from the Economic Cooperation Administration that Bureau engineers review the plans for the proposed Fasideri Dam in Greece. In consultation with two engineers from Greece, engineers in the Branch of Design and Construction suggested changes in the design of the dam and made specific recommendations for modifications in the basic designs.

Through arrangements with a consulting engineering firm in the United States, the Bureau engineers undertook the highly complex problem of analyzing the stresses for the 850-foot-high concrete Kosi Dam which is to be constructed by the Indian Government.

Materials testing, hydraulic model investigations, and other studies made in the Denver laboratories of the Bureau were undertaken for several foreign agencies, including those of India, Colombia, Portugal, and Greece.

The Bureau is receiving increasingly numerous inquiries by mail from individuals in foreign countries requesting engineering data on a diversity of highly complex problems. Questions received concerned such topics as the selection of turbines for hydroelectric generating plants, techniques and methods for lining canals, design of earth dams, and design of irrigation distribution systems.

Experienced engineers were lent to various foreign governments in connection with water resources development. Requests for these assignments were received through the Department of State and were made under provisions of Public Law 402, Eightieth Congress, with recipient countries bearing the costs. Foreign assignments varied from 2 months to 1 year. Countries receiving this type of assistance were Ceylon, Colombia, India, Japan, Southern Rhodesia, and Venezuela. In addition, Bureau engineers were lent to ECA to assist in its reclamation programs in Greece and Italy.

As official representatives of the United States Government, Bureau engineers attended international engineering conferences at Cairo, Egypt; Rotterdam, Holland; Paris, France; and Stockholm, Sweden. Delegates to the Rotterdam and Stockholm conferences also visited Paris where they furnished advice and consultation to the Administrator, ECA, on important engineering problems. One delegate represented the Bureau of Reclamation at an international engineering conference in Rio de Janeiro.

TABLE 6.—*Bureau of Reclamation dams*

State and project	Name of dam	River	Type	Capacity	Height	Length	Volume	Year
Arizona:								
Salt River.....	Bartlett.....	Verde	Concrete multiple-arch.....	2 179,500	287	1,063	182,000	1939
	Cave Creek.....	do.	do.	11,000	109	1,648	18,775	1923
	Horse Mesa.....	Salt	Concrete arch, powerplant.....	2 415,100	300	803	162,000	1927
	Mormon Flat.....	do.	do.	2 37,900	224	505	59,900	1925
	Roosevelt.....	do.	Masonry arch-gravity, powerplant.....	2 1,398,000	280	1,125	355,800	1911
	Stewart Mountain.....	do.	Concrete arch, powerplant.....	69,800	207	1,260	120,500	1930
Alizona-California:								
Parker Dam power.....	Parker I.....	Colorado.....	do.	717,000	320	856	380,000	1933
Arizona-Nevada:								
Boulder Canyon.....	Hoover (Boulder).....	do.	Concrete arch-gravity, 2 powerplants.....	31,142,000	726	1,244	4,400,000	1936
Davis Dam.....	Davis.....	do.	Earth, powerplant.....	1,820,000	200	1,600	4,357,500	(*)
California:								
Central Valley.....	Friant I.....	San Joaquin.....	Concrete gravity.....	521,000	319	3,488	2,135,000	1942
	Keswick 3.....	Sacramento.....	do.	23,800	159	1,046	1,97,000	(*)
	Shasta.....	do.	Concrete curved-gravity, embankment wing, power plant.....	4,493,000	602	3,400	6,541,000	1945
	Martinez.....	Offstream.....	Earth.....		38	1,200	183,450	1947
	East Park.....	Little Stony Creek.....	Concrete arch-gravity.....	51,000	139	226	15,745	1910
Orland.....	Stony Gorge.....	Stony Creek.....	Concrete slab-and-buttress.....	2 30,200	139	868	43,100	1928
Colorado:								
Colorado-Big Thompson.....								
	Dixon Canyon.....	Offstream.....	Earth.....	(6)	240	1,215	3,004,000	1949
	Granby.....	Colorado.....	do.	546,000	245	885	2,901,300	1949
	Green Mountain.....	Blue.....	Earth, powerplant.....	154,600	200	1,150	4,405,000	1943
	Horseshoe.....	Offstream.....	Earth.....	147,000	150	1,610	1,890,000	1949
	Marys Lake 3.....	do.	Earth (2 dikes), power plant.....	40	1,300	60,500	(*)	
	Olympus I.....	Big Thompson.....	Concrete gravity, embankment wing.....	2,850	60	1,850	300,000	1919
	Shadow Mountain.....	Colorado.....	Earth.....	15,000	44	600	210,000	1946
	Soldier Canyon.....	Offstream.....	do.	(6)	220	1,420	3,288,000	1949
	Spring Canyon.....	do.	do.	(6)	215	1,115	2,213,000	1948
Fruit Growers.....								
Manos.....	Fruit Growers.....	Alfalfa Run.....	do.	4,600	55	1,520	135,500	1938
Pine River.....	Jackson Gulch.....	Offstream.....	do.	10,000	181	1,895	1,988,000	1948
Uncompahgre.....	Vallejo.....	Pine.....	do.	129,700	162	4,010	3,738,000	1941
San Luis Valley.....	Taylor Park.....	Concejos.....	do.	2 106,200	296	675	1,115,100	1937
	Platoro.....	do.	do.	67,000	155	1,525	940,000	(*)
Idaho:								
Minidoka.....	American Falls.....	Snake.....	Concrete gravity, embankment wings.....	2 1,700,000	94	5,227	313,600	1927
	Jackson Lake.....	do.	do.	2 847,000	70	4,920	491,700	1911
	Minidoka I.....	do.	Earth with concrete power house section, power plant.....	2 95,200	86	4,475	257,300	1906
	Grassy Lake.....	Grassy Creek.....	Earth.....	15,500	118	1,170	541,600	1939
	Island Park.....	Snake, Henrys Fork.....	do.	127,600	91	9,448	404,000	1938



Idaho-Oregon: Boise	Anderson Ranch	Boise, North Fork	Earth, power plant	493,200	456	1,350	9,633,300	(4)
	Arrowrock	Boise	Concrete arch-gravity	2 285,600	354	1,150	495,000	1915
	Cascade	Payette, North Fork	Earth	700,000	107	785	395,000	1948
	Deadwood	Deadwood	Concrete arch	164,000	105	749	56,400	1931
	Deer Flat, Upper	Offstream	Earth	74	4	4,000	1,245,000	1908
	Deer Flat, Lower	do	do	190,100	46	7,200	1,240,000	1913
Kansas	Deer Flat, Middle	do	do	16	16	950	22,500	1908
	Cedar Bluff	Smoky Hill	do	368,100	103	11,000	8,917,000	(4)
	Bonny	South Fork, Republican	do	175,000	160	9,265	8,530,000	(4)
Kansas-Colorado: St. Francis (Missouri River Basin).	Como	Rock Creek	do	34,800	65	2,550	1,106,000	1910
	Hungry Horse	Flathead, South Fork	Concrete arch-gravity power plant	3,500,000	564	2,115	2,900,000	(4)
	Antla	Offstream	Earth	2 400	42	1,050	142,800	1937
Montana:	Presto	Milk	do	129,100	111	2,070	105,000	1939
	Nelson	Offstream	Earth (5 dikes)	85,500	28	9,900	232,600	1915
	Sherburne Lakes	Swiftcurrent Creek	Earth	266,100	96	1,085	227,600	1921
Sun River	Gibson	Sun, North Fork	Concrete arch	2 105,000	196	1,960	167,500	1929
	Pishkun	Offstream	Earth (8 dikes)	46,400	50	9,180	599,300	1921
	Willow Creek	Willow Creek	Earth, semihydraulic fill	2 32,400	93	650	254,186	1911
Canyon Ferry (Missouri River Basin).	Canyon Ferry	Missouri River	Concrete, gravity	2,050,000	220	1,010	455,600	(4)
	Enders	Frenchman Creek	Earth	74,000	134	2,603	1,951,000	(4)
	Box Butte	Niobrara	do	31,300	87	5,508	1,422,000	1946
Mirage Flats	Medicine Creek	Medicine Creek	do	93,000	180	5,630	2,883,000	(4)
	Trenton	Republican	do	172,000	95	7,800	(5)	(4)
Frenchman-Cambridge (Missouri River Basin).	Guernsey	North Platte	Earth, power plant	48,100	135	560	586,200	1927
	Lake Alice, upper	Offstream	Earth	11,400	30	3,100	240,000	1913
	Lake Alice, lower	do	do	260,800	23	2,330	113,000	1912
Nebraska-Vermont: North Platte	Minatare	do	do	2 60,800	63	3,700	696,100	1915
	Pathfinder	North Platte	Masonry arch-gravity	2 1,070,000	214	1,070	63,700	1900
	Pathfinder dike	do	Earth	38	38	1,650	152,200	1909
Nevada:	Rye Patch	Humboldt	do	2 179,000	80	914	356,300	1936
	Lahontan	Garon	Earth, power plant	2 273,000	162	5,400	731,100	1915
	Lake Tahoe 1	Truckee	Concrete slab-and-buttress, lake outlet regulator	2 732,000	16	109	430	1913
Nevada-California: Truckee River storage	Boca	Little Truckee	Earth	41,200	116	1,629	911,900	1939
	Alamogordo	Pecos	Earth and rockfill	156,800	148	3,084	1,914,900	1937
	Avalon 1	do	Earth	7,000	58	1,025	202,300	1891
New Mexico: Carlsbad	McMillan	do	do	38,700	57	2,114	234,000	1894

See footnotes at end of table.

TABLE 6.—Bureau of Reclamation dams—Continued

State and project	Name of dam	River	Type	Capacity	Height	Length	Volume	Year
New Mexico-Texas:								
Rio Grande.....	Caballo <sup>1</sup> .....	Rio Grande.....	Earth.....	345,900	112	4,558	1,244,200	1938
	Elephant Butte.....	do.....	Concrete gravity, power plant (1940).	2,219,000	301	1,674	629,500	1916
North Dakota:								
Heart Butte (Missouri River Basin).	Heart Butte.....	Heart River.....	Earth.....	450,000	174	1,850	1,222,000	( <sup>4</sup> )
Dickinson (Missouri River Basin).	Dickinson.....	do.....	do.....	16,500	69	2,225	326,000	( <sup>4</sup> )
Oklahoma:								
W. C. Austin.....	Altus <sup>1</sup> .....	Red, North Fork.....	Concrete gravity, masonry-faced.	2,151,700	110	1,112	70,200	1945
Oregon:								
Baker.....	Thief Valley.....	Powder.....	Concrete slab-and-buttress	17,400	70	390	6,288	1932
Burnt River.....	Unity.....	Burnt.....	Earth, rock-faced	25,800	83	675	253,600	1938
Deschutes.....	Crane Prairie.....	Deschutes.....	Earth.....	55,300	36	285	29,700	1940
	Wickiup.....	do.....	do.....	100	100	13,800	1,852,000	1949
	Wickiup-East Dike.....	do.....	do.....	250,000	28	3,420	793,400	1949
Umatilla.....	Cold Springs.....	Offstream.....	do.....	180,000	117	3,450	2,363,800	1908
	McKay.....	McKay Creek.....	Earth, concrete-faced	2,73,800	180	2,700	645,300	1927
Vale.....	Agency Valley.....	Malheur, North Fork.....	Earth.....	59,900	110	1,850	19,500	1935
	Warm Springs.....	Malheur, Middle Fork.....	Concrete arch.....	192,400	106	469	63,400	1919
Oregon-California:								
Klamath.....	Clear Lake.....	Lost.....	Earth.....	527,000	39	840	11,900	1910
	Gerber.....	Miller Creek.....	Concrete arch.....	294,300	88	485	2,200	1925
	Link River.....	Link.....	Concrete slab-and-buttress, lake outlet regulator.	2,873,000	22	435	537,500	1921
Oregon-Idaho:								
Owyhee.....	Owyhee <sup>1</sup> .....	Owyhee.....	Concrete arch-gravity.....	1,120,000	417	833	749,600	1932
South Dakota:								
Angostura (Missouri River Basin).	Angostura.....	Cheyenne.....	Concrete gravity, embankment wing.	220,000	187	1,900	1,783,200	( <sup>4</sup> )
Belle Fourche.....	Belle Fourche.....	Owl Creek.....	Earth, concrete-faced	2,177,500	122	6,262	407,400	1911
Rapid Valley.....	Deerfield.....	Castle Creek.....	Earth.....	15,700	135	825	3,300,000	1947
Shadecreek (Missouri River Basin).	Shadecreek.....	Grand.....	do.....	467,000	145	1,900	3,579,000	( <sup>4</sup> )
Texas:								
Colorado River.....	Marshall Ford.....	Colorado (Texas).....	Concrete gravity, embankment wings, power plant.	1,951,300	278	5,093	435,600	1942
Utah:								
Hyrum.....	Hyrum <sup>1</sup> .....	Little Bear.....	Earth.....	18,900	116	540	138,900	1935
Moon Lake.....	Moon Lake.....	do.....	do.....	5,800	54	663	513,100	1937
	Moon Lake.....	Lake Fork, West Fork.....	do.....	2,35,800	110	1,108	410,000	1938
Newton.....	Newton.....	Clarkson Creek.....	do.....	5,500	101	4,781	267,700	1946
Ogden River.....	Pine View.....	Ogden.....	do.....	430	103	367	307,700	1937
Provo River.....	Deer Creek.....	Provo.....	do.....	152,500	235	1,304	2,827,900	1941

State	Dam	Price	Height	Capacity	Year
Washington:	Scofield Dam.	do	do	73, 900	125
	Strawberry Valley	do	do	283, 000	79
	Weber River	do	do	73, 900	158
	Echo	do	do	73, 900	187
Columbia Basin:	Grand Coulee.	Columbia	Concrete gravity, 2 power plants and pumping plant.	9, 517, 000	550
	South Coulee.	Offstream	Earth	1, 484, 000	94
	North Coulee.	do	do	145	145
	Long Lake.	do	do	62, 700	130
Okanogan:	O'Sullivan.	Lower Crab Creek	do	606, 000	200
	Concomully.	Salmon Creek	Earth, hydraulic fill.	2 13, 000	70
	Salmon Lake.	do	Earth	2 10, 500	42
	Bumping Lake.	Bumping	do	37, 300	45
Yakima	Clear Creek.	Tieton, North Fork.	Concrete arch	5, 300	80
	Cle Elum.	Cle Elum	Earth	529, 200	135
	Kachess.	Kachess	do	229, 000	114
	Keechelus.	Yakima	do	170, 500	103
Wyoming:	Tieton.	Tieton	Earth, semihydraulic fill.	2 197, 000	235
	Boysen (Missouri River Basin).	Big Horn	Earth, power plant.	1, 493, 000	290
	Kendrick.	North Platte	Earth	190, 700	265
	Alcova.	do	Concrete arch, power plant.	2 1, 026, 000	295
Kortes Power (Missouri River Basin).	Seminole.	do	do	4, 800	240
	Kortes.	do	Concrete gravity, power plant.	do	do
	Bull Lake.	Bull Lake Creek	Earth	2 152, 000	81
	Philo Butte.	Offstream	Earth, semihydraulic fill.	2 31, 600	51
Wyoming-Montana:	Deaver.	do	Earth	680	14
	Ralston.	do	do	1, 500	35
	Buffalo Bill.	Shoshone	Concrete arch, power plant.	2 456, 600	325
	Shoshone.	do	do	do	do

<sup>1</sup> Storage and diversion—dam classified according to its principal feature.

<sup>2</sup> Live storage—dead storage not evaluated.

<sup>3</sup> Power dam—water supply for generation of power.

<sup>4</sup> Under construction.

<sup>5</sup> Horsetooth Reservoir formed by 4 dams.

<sup>6</sup> Not available.

#### NOTES

Capacity: Storage dams—acre-feet of reservoir storage provided by highest controlled water surface; diversion dams—second-foot of diversion provided by canal headworks at dam.

Height: Storage dams—feet between lowest point in foundation and normal crest of dam; diversion dams—feet between original streambed and highest controlled water surface.

Length: Feet of barrier in dam and integral features constructed between natural abutments.

Volume: Cubic yards of all material in dam and its appurtenant features.

Year: Date original construction was completed. (Tabular data include supplemental construction.)



<i>Oregon</i>													
Baker.....													
Burnt River.....													
Deschutes (Central Oregon irri- gation district).....													
Deschutes (north unit).....													
Stanfield.....	43,732	26,715	27,535	3,009,205	109.20								
Umatilla:													
East division.....	10,911	8,179	8,179	327,895	40.09								
West division.....	7,620	5,001	5,276	220,093	41.72								
Total—Umatilla project.....	18,531	13,180	13,455	547,990	40.73								
Vale.....	32,000	31,550	31,550	2,712,603	85.95								
Westland.....													
<i>Oregon-Idaho</i>													
Owyhee:													
Advancement irrigation dis- trict.....	701	603	603	60,895	100.99	0	0						
Bench irrigation district.....	2,311	2,205	2,205	432,448	196.12	0	0						
Crystal irrigation district.....	1,263	1,137	1,137	217,743	191.51	0	0						
Gen irrigation district (Idaho).....	31,287	27,330	26,491	2,979,496	112.47	839	54,974						
Ontario-Nyssa irrigation dis- trict.....	5,863	5,357	5,357	863,751	161.24	0	0						
Owyhee irrigation district.....	56,199	50,119	50,299	5,359,588	106.55	0	0						
Payette-Oregon Slope irri- gation district.....	4,617	4,139	4,139	957,631	231.37	0	0						
Slide irrigation district.....	1,092	1,072	1,072	160,487	149.71	0	0						
Total—Owyhee project.....	103,333	91,962	91,303	11,032,039	120.83	839	54,974						
<i>Washington</i>													
Columbia Basin.....	5,743	232	235	18,740	79.74								
Okanogan.....	5,346	3,733	3,850	1,533,518	398.32								
Yakima:													
Kittitas division.....	69,552	54,325	54,821	3,615,536	65.95	97	776						
Rozz division.....	44,570	37,461	37,329	7,559,677	202.51	121	8,132						
Sunnyside division.....	103,579	83,469	83,698	13,146,462	157.07	381	24,757						
Tieton division.....	27,276	24,546	24,689	9,137,339	370.10	0	0						
Total—Yakima project.....	244,977	199,801	200,537	33,459,205	166.85	599	33,665						
Total—Region 1.....	883,984	754,283	757,329	89,675,265	114.45	1,471	19,390	195,985	179,565	180,765	13,005,078	71.94	1,046,382

See footnotes at end of table.

7,312 15,291 44,218 6,000 7,255 15,290 42,350 5,073 7,255 15,290 42,350 5,073 279,600 511,052 4,622,136 297,787 38.54 33.49 109.14 52.79 916 878 1,025 243,128 50.45 13,130 13,130 2,177,936 165.87 162,873 26,842,468 164.81 191,440 164,307 162,873 26,842,468 164.81 971,178 939,160 102,761,752 106.03



TABLE 7.—*Projects in operation—irrigation and crop value data for the calendar year 1948—Continued*

[illegible]





[illegible]

See footnotes at end of table.

TABLE 7.—*Projects in operation—irrigation and crop value data for the calendar year 1948—Continued*

State, project, and subdivisions	Projects entirely constructed by the Bureau						Projects furnished supplemental storage water from works constructed by the Bureau						Special and Warren Act contractors receiving water from Bureau-constructed works																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
	Irrigable area 1	Irrigated area	Land subject to construction charges			Temporarily suspended lands 2		Irrigable area 1	Irrigated area	Net area in cultivation	Total crop values	Irrigable area 1	Irrigated area	Net area in cultivation	Total	Per acre	Irrigable area	Irrigated area	Net area in cultivation	Total	Per acre																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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Projects entirely constructed by the Bureau										
Summary	Irrigable area <sup>1</sup>	Irrigated area	Land subject to construction charges			Temporarily suspended lands <sup>2</sup>		Total crop values	Total	
			Net area in cultivation	Crop values		Net area in cultivation	Total			
				Total	Per acre					
Region 1.....	886,984	754,283	757,329	\$86,675,265	\$114.45	1,471		\$91,399		
Region 2.....	97,112	85,209	84,127	9,797,531	116.46	1,197		46,222		
Region 3.....	337,854	284,340	293,059	50,067,272	170.84	1,261		21,788		
Region 4.....	244,323	188,166	185,359	11,722,594	63.24	4,572		107,993		
Region 5.....	235,637	209,384	210,118	47,883,438	227.89	0		0		
Region 6.....	548,921	372,644	408,027	18,161,454	44.51	20,264		440,885		
Region 7.....	255,771	214,376	190,120	11,370,472	59.81	24,638		407,122		
Total.....	2,606,602	2,108,402	2,128,139	235,678,056	110.74	52,403		1,115,409		
Special and Warren Act contractors receiving water from Bureau constructed works										
Summary	Irrigable area <sup>1</sup>	Irrigated area	Net area in cultivation	Crop values		Irrigable area	Irrigated area	Net area in cultivation	Crop values	
				Total	Per acre				Total	Per acre
Region 1.....	195,985	179,565	180,765	\$13,005,078	\$71.94	1,046,382	971,178	969,160	\$102,761,752	\$106.03
Region 2.....	0	0	0	0	0	304,035	262,042	279,196	37,539,605	134.46
Region 3.....	0	0	0	0	0	626,683	503,225	522,286	103,042,956	197.29
Region 4.....	374,517	314,725	317,787	23,463,797	73.84	20,013	19,067	19,124	1,435,785	75.08
Region 5.....	10,550	7,144	7,144	682,704	95.56	20,301	17,153	17,153	3,497,881	233.04
Region 6.....	10,735	9,342	15,342	279,887	18.24	1,512	1,512	1,512	67,158	44.42
Region 7.....	0	0	0	0	0	139,625	119,959	130,810	8,618,030	65.88
Total.....	591,787	510,776	521,038	37,431,466	71.76	2,158,551	1,894,136	1,939,241	257,462,667	132.76

TABLE 7.—*Projects in operation—irrigation and crop value data for the calendar year 1948—Continued*

Summary	Projects entirely constructed by the Bureau				
	Irrigable area <sup>1</sup>	Irrigated area	Land subject to construction charges		Per acre
			Net area in cultivation	Crop values	
			Total		
Totals—regular projects.....	2,606,602	2,108,402	2,128,139	\$235,678,036	\$110.74
Totals—storage projects.....	591,787	510,776	521,038	37,431,466	71.76
Totals—special and Warren Act contractors.....	2,158,551	1,894,136	1,939,241	257,402,667	132.76
Additional areas reported:					
Temporarily suspended.....	-----	-----	52,403	1,115,409	21.29
Leased areas.....	-----	45,441	58,913	2,935,943	49.84
Total.....	5,356,940	4,558,755	4,699,734	534,623,541	113.76
Additional irrigable lands, no crop details reported <sup>2</sup> .....	23,075	-----	-----	-----	-----
Grand total.....	5,380,015	4,558,755	4,699,734	534,623,541	113.76
Grand total 1947.....	5,166,783	4,461,702	4,554,352	555,420,804	121.95
Increase and decrease, 1947-48 totals.....	+213,232	+97,053	+145,382	-20,797,263	-8.19

<sup>1</sup> Area for which the Bureau is prepared to supply water.<sup>2</sup> Generally part of irrigable area but not subject to construction charges until reclaimed.<sup>3</sup> Water conservation and utilization project.<sup>4</sup> Private project reconstructed with Government funds.<sup>5</sup> Includes 61,268 acres, producing crops valued at \$6,599,148, outside the permanent project service area, furnished water from project facilities under interim contracts.<sup>6</sup> Although there are 17,862 acres that can be irrigated within project limits, the area for which there is considered to be a safe and reliable water supply is 155,000 acres.<sup>7</sup> Includes Arnold and Lone Pine irrigation districts, Deschutes project, and Indian reservation lands on Pine River project.

NOTE.—Per acre value based on net area in cultivation.

TABLE 8.—Cumulative crop values—1906-1948

Year	Federal irrigation projects <sup>1</sup>			Warren Act lands and special contractors			Entire area			
	Irrigated acreage	Total crop value		Irrigated acreage	Net area in cultivation	Total crop value		Net area in cultivation	Total crop value	
		For year	Cumulative total			For year	Cumulative total		For year	Cumulative total
1906.....	22,300	\$244,900	\$5,005,360	2,501,100	2,481,600	\$35,000,000	22,300	2,200	\$214,900	\$5,005,360
1907.....	187,628	4,700,460	12,641,248	916,313	880,613	47,368,468	187,628	2,169,000	4,700,460	12,641,248
1908.....	289,549	7,635,888	28,561,911	981,940	950,900	47,886,750	289,549	2,290,500	7,635,888	28,561,911
1909.....	410,628	11,920,639	37,506,550	1,001,250	969,550	45,288,630	410,628	2,369,500	11,920,639	37,506,550
1910.....	471,423	12,944,639	50,592,991	1,083,260	951,270	33,240,840	471,423	2,127,500	12,944,639	50,592,991
1911.....	562,311	13,086,441	66,000,125	1,051,380	923,140	37,557,860	562,311	2,172,000	13,086,441	66,000,125
1912.....	614,477	16,007,134	82,576,534	1,030,670	880,160	43,297,470	614,477	2,105,000	16,007,134	82,576,534
1913.....	694,142	15,676,409	98,752,517	1,019,170	951,250	53,655,850	694,142	2,239,470	15,676,409	98,752,517
1914.....	791,271	16,475,517	115,916,503	1,097,190	948,580	43,750,040	791,271	2,275,000	16,475,517	115,916,503
1915.....	810,649	32,815,972	149,732,475	1,072,486	948,580	43,750,040	810,649	2,309,296	32,815,972	149,732,475
1916.....	922,821	56,462,313	206,194,788	1,192,020	1,192,020	62,400,320	922,821	2,371,500	56,462,313	206,194,788
1917.....	1,129,666	66,821,396	273,016,184	1,253,020	1,192,020	72,720,490	1,129,666	2,409,938	66,821,396	273,016,184
1918.....	1,187,255	88,974,137	362,161,971	1,485,115	1,072,486	62,400,320	1,187,255	2,539,210	88,974,137	362,161,971
1919.....	1,223,480	66,171,650	428,333,621	1,392,990	1,192,020	72,720,490	1,223,480	2,677,105	66,171,650	428,333,621
1920.....	1,297,500	49,630,300	477,782,271	1,234,230	1,234,230	84,360,340	1,297,500	2,718,130	49,630,300	477,782,271
1921.....	1,202,130	50,340,850	528,123,121	1,286,046	1,254,493	54,664,340	1,202,130	2,790,866	50,340,850	528,123,121
1922.....	1,213,700	55,046,300	583,169,421	1,254,493	1,254,493	54,664,340	1,213,700	2,816,607	55,046,300	583,169,421
1923.....	1,240,800	66,438,500	649,607,921	1,196,400	1,196,400	54,664,340	1,240,800	2,848,605	66,438,500	649,607,921
1924.....	1,210,300	77,608,880	727,216,801	1,239,017	1,239,017	54,664,340	1,210,300	2,878,576	77,608,880	727,216,801
1925.....	1,431,020	60,336,620	787,553,421	1,285,051	1,229,594	43,179,631	1,431,020	2,903,180	60,336,620	787,553,421
1926.....	1,378,990	70,985,460	858,538,881	1,335,995	1,272,745	47,599,062	1,378,990	2,933,180	70,985,460	858,538,881
1927.....	1,442,080	80,238,800	938,777,681	1,389,338	1,389,338	45,704,623	1,442,080	2,958,187	80,238,800	938,777,681
1928.....	1,483,960	87,539,670	1,026,317,351	1,422,417	1,422,417	45,704,623	1,483,960	3,001,919	87,539,670	1,026,317,351
1929.....	1,504,510	64,418,940	1,090,736,291	1,474,303	1,474,303	40,313,140	1,504,510	3,034,789	64,418,940	1,090,736,291
1930.....	1,462,865	40,121,089	1,130,857,381	1,218,108	1,218,108	37,690,481	1,462,865	3,070,072	40,121,089	1,130,857,381
1931.....	1,522,718	31,165,752	1,162,023,131	1,202,172	1,202,172	49,486,191	1,522,718	3,106,699	31,165,752	1,162,023,131
1932.....	1,589,770	48,168,337	1,210,191,461	1,562,046	1,562,046	116,426,761	1,589,770	3,141,346	48,168,337	1,210,191,461
1933.....	1,565,144	59,628,327	1,269,819,781	1,602,907	1,602,907	170,606,761	1,565,144	3,173,732	59,628,327	1,269,819,781
1934.....	1,532,124	63,601,663	1,333,421,441	1,664,861	1,664,861	196,543,084	1,532,124	3,201,969	63,601,663	1,333,421,441
1935.....	1,640,196	72,902,818	1,406,324,251	1,829,531	1,829,531	250,912,645	1,640,196	3,231,969	72,902,818	1,406,324,251
1936.....	1,702,192	81,422,417	1,487,746,661	1,871,999	1,871,999	257,402,697	1,702,192	3,262,300	81,422,417	1,487,746,661
1937.....	1,725,464	72,838,649	1,560,585,301	1,894,136	1,894,136	257,402,697	1,725,464	3,293,734	72,838,649	1,560,585,301
1938.....	1,777,584	73,709,654	1,634,294,951	1,218,108	1,218,108	40,313,140	1,777,584	3,324,969	73,709,654	1,634,294,951
1939.....	1,922,088	80,098,196	1,714,393,141	1,258,262	1,258,262	37,690,481	1,922,088	3,356,442	80,098,196	1,714,393,141
1940.....	2,152,808	110,399,806	1,824,792,941	1,202,172	1,202,172	49,486,191	2,152,808	3,388,670	110,399,806	1,824,792,941
1941.....	2,277,955	135,619,716	1,960,412,651	1,335,995	1,335,995	45,704,623	2,277,955	3,421,699	135,619,716	1,960,412,651
1942.....	2,422,288	2,259,653	2,186,072,301	1,422,417	1,422,417	49,486,191	2,422,288	3,454,349	2,259,653	2,186,072,301
1943.....	2,479,958	2,398,922	2,425,462,221	1,602,907	1,602,907	170,606,761	2,479,958	3,486,281	2,398,922	2,425,462,221
1944.....	2,408,842	2,476,250	2,672,912,471	1,664,861	1,664,861	196,543,084	2,408,842	3,518,945	2,476,250	2,672,912,471
1945.....	2,416,961	2,545,321	2,928,457,791	1,745,627	1,745,627	202,639,074	2,416,961	3,551,352	2,545,321	2,928,457,791
1946.....	2,613,687	2,567,050	3,185,028,841	1,808,282	1,808,282	250,912,645	2,613,687	3,582,401	2,567,050	3,185,028,841
1947.....	2,626,737	3,038,537	3,488,566,371	1,871,999	1,871,999	257,402,697	2,626,737	3,613,552	3,038,537	3,488,566,371
1948.....	2,664,619	2,777,160,874	3,515,697,934	1,894,136	1,894,136	257,402,697	2,664,619	3,640,976	2,777,160,874	3,515,697,934

<sup>1</sup> Includes projects constructed by the United States and those for which supplemental water is furnished from storage works built by United States. \* Estimated.

## OPERATION AND MAINTENANCE

Operation and maintenance is the phase of Reclamation most closely integrated with the Bureau's entire program from the very first time an irrigation project is considered for construction until long after water has begun to flow down the ditch.

Operation and maintenance means providing irrigation water for more than 100,000 settlers on over 5 million acres of land, preparing lands for settlement where ultimately many times the present number of settlers will become Reclamation farmers, and last but not least to see that thousands of miles of irrigation facilities throughout the 17 Western States are kept in good working order to conserve and use the water to the greatest advantage and assure service to the people of that area.

Operation of the 60 irrigation projects, or divisions of projects, completed by the Bureau, including the use of water, maintenance of irrigation systems, the production of crops and livestock, and the general welfare of the water users on the land are problems of primary concern to every Reclamation employee from the man on the ditch to the Commissioner.

The Government has invested large sums of money in these projects and it is of paramount importance that they be maintained on a sound financial, agricultural and economic basis if the settlers are to succeed and the Government is to realize full return on its investment.

Noteworthy operation and maintenance accomplishments during the year were the large number of repayment and amendatory contracts which were executed in compliance with a directive from Congress. A report on this situation was made to Congress and to irrigation groups in February 1949.

A considerable amount of work was completed under the newly launched rehabilitation and betterment program, progress was noted on the lower cost canal lining program, sprinkler irrigation studies, as well as continuing improvement in weed-control activities. Hundreds of veterans-settlers profited from the new development farms, as well as from the various agreements executed by the Bureau with the United States Department of Agriculture and State agricultural colleges. Through these agreements assistant county extension agents help advise in matters relative to crops and livestock, and advise on numerous other problems which confront new homesteaders.

### *Crop Production*

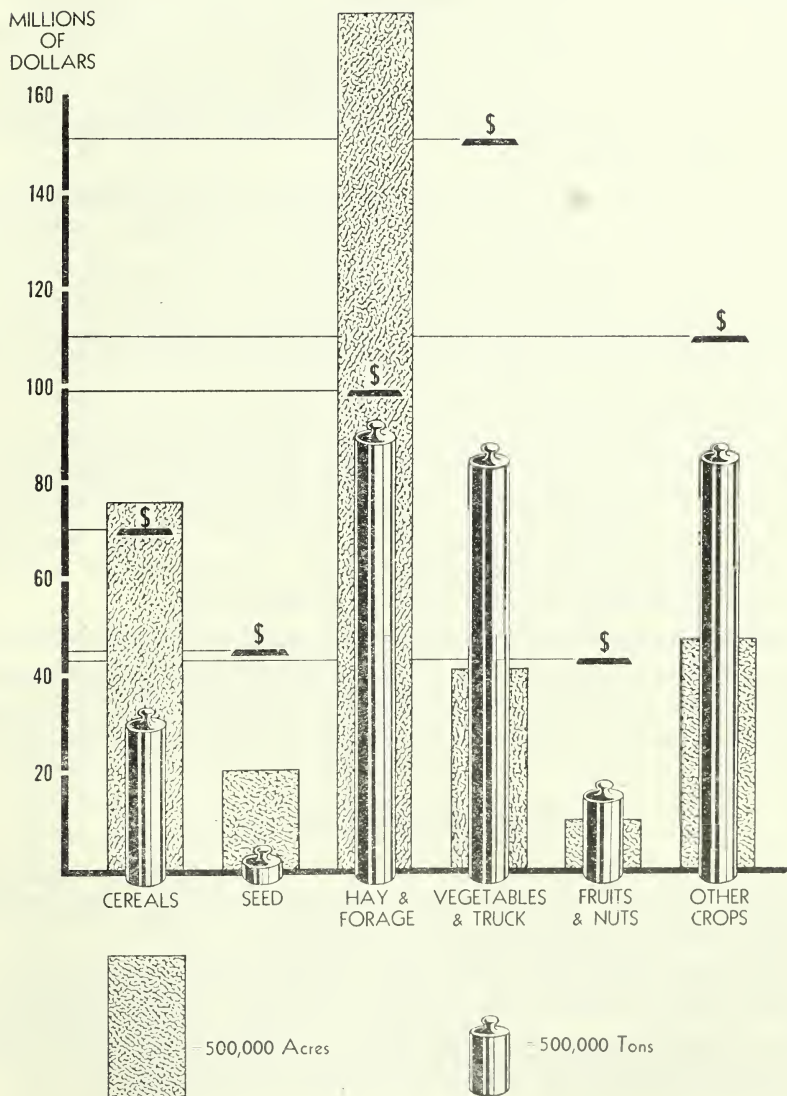
Crops valued at \$534,623,541 and averaging \$113.76 per acre were produced in 1948 on 60 Federal Reclamation projects or divisions of



# CROP RESULTS

on Federal Reclamation Projects

in 1948



projects. This was the third consecutive year in which crop values exceeded one-half billion dollars despite some decline in prices. Of the value of crops produced, approximately 42 percent were food crops, 32 percent grain and forage, 11 percent cotton fiber, 10 percent seed crops (including cottonseed) and about 5 percent of the value was represented by miscellaneous crops and payments to water users by the Government and commercial agencies. The cumulative value of irrigation crops grown on Federal Reclamation projects since 1906 totals slightly more than 6 billion dollars.

The volume of crops harvested in 1948 totaled 13,258,688 tons. Prices received by farmers averaged somewhat lower and production costs continued at a high level. Significant shortages of surface water supplies were experienced on the Salt River, Rio Grande, Carlsbad, and Moon Lake projects.

The population on the 69,146 farms on regular Bureau projects and storage projects is estimated at 235,100 and the population on 23,322 farms served under Warren Act or special contracts is estimated at 93,400, making a total of about 328,500 people on 92,468 irrigated farms. Towns in and adjacent to these irrigation project areas, numbering about 370, have a population of approximately 1,298,000. The Reclamation area population therefore totals about 1,626,500.

Irrigated farms served by Federal Reclamation have increased from 86,181 in 1941 to 92,468 in 1948 and the over-all population of the farms and adjacent towns has increased during this same period from 1,088,500 to 1,626,500. In 1941, there were about 126 banks in which 237,600 depositors held about \$269,000,000. In 1948, 563,400 depositors held \$1,143,000,000 in 181 banking establishments.

The inventory value of livestock and equipment on Federal Reclamation projects as of November 1, 1948, was \$221,273,287 which exceeded the previous year's value by \$35,965,191. Livestock were valued at \$99,253,237, and equipment, including motor vehicles, at \$122,020,050.

### *Extension of Irrigation Service*

Irrigation facilities were extended in 1948 by the Bureau whereby irrigation service could be provided for 5,380,015 acres, an increase of 213,232 acres over that of the previous crop year.

The area irrigated in 1948 totaled 4,458,755 acres, an increase of 97,053 acres over that of the previous crop year. Projects reporting the principal amount of this increase in acreage irrigated through facilities constructed by the Bureau include the following:

	<i>Irrigated</i>	
	<i>Farms</i>	<i>Acres</i>
Tucumcari project, New Mexico-----	123	9,823
W. C. Austin project, Oklahoma-----	227	14,160
Riverton project, Wyoming-----	65	4,200
Shoshone project, Wyoming-----	30	1,535
Buffalo Rapids project (second division), Montana-----	2	243
All-American Canal project, Coachella division, California-----	13	1,275
Gila project, Yuma Mesa division, Arizona-----	8	<sup>1</sup> 1,460
Kendrick project, Wyoming-----	15	682
Mirage Flats project, Nebraska-----	16	2,152
Colorado-Big Thompson project, Colorado-----	290	23,000
Newlands project, Nevada-----		372
Boise project, Payette division, Idaho-----	65	1,861
Deschutes project, north unit, Oregon-----	213	13,200
Deschutes project, Arnold irrigation district, Oregon-----	189	2,964
Minidoka project, Idaho-----	41	2,736
Yakima project, Roza division, Washington-----	255	6,408
Rathdrum Prairie project, Post Falls unit, Idaho-----	7	1,083
Central Valley project, California-----	208	7,422
Total <sup>2</sup> -----	1,821	94,576

<sup>1</sup> Does not include area irrigated by Bureau prior to 1948 which was divided into 54 farm units.

<sup>2</sup> Does not include area irrigated under lease prior to 1948 comprising 8,283 acres, on which 86 farm units were opened for homestead settlement on Klamath project in 1948.

The difference between the acreage for which irrigation facilities have been provided and the acreage irrigated is due principally to the need for allowing land to fallow for a season and, to a lesser degree, to the need for completion of distribution systems.

### *Operation and Maintenance of Irrigation Systems*

During the year, activities relating to the operation of storage, regulation, and distribution of irrigation water supplies were the prime business on operating projects. Irrigation water was delivered to the water users during fiscal year 1949 without a major break in the distribution system of any Bureau-operated project. Crops were profitably matured on all operating projects during the year despite some water shortages which occurred in the Southwest. On some projects where surface water was not adequate, ground water was pumped to supplement surface water supply. Programs for the control of irrigation transmission losses, sprinkler irrigation, reuse of return flows, project rehabilitation, and other items of water conservation were aggressively pursued so that the full utilization of our water resources might be accomplished.

In accordance with established congressional and Bureau policy, three projects were transferred to the waters users for operation dur-

ing the year. These were Grand Valley in Colorado, Belle Fourche in South Dakota, and Vale in Oregon. Negotiations are now under way for the transfer of the Carlsbad project in New Mexico to the water users.

Additional drains were constructed to relieve areas of high ground water, and surveys were made to determine the extent and solution of future drainage problems.

### *Cooperation With Design and Construction*

As cooperation is a "must" between experienced operation and maintenance personnel and the planning and designing forces in any large construction organization, the Chief Engineer has taken positive steps to make certain members of both branches cooperate in ironing out possible future problems which may arise in the design stage of any structure.

He is arranging for the appointment of an engineer experienced in both design and operation, whose chief duty will be to find examples of unusually good or bad operating results and pass this information along to the designing staff. In some regions, groups of designers have inspected operating projects with operating personnel, who point out the salient favorable or unfavorable features of the development. A start has been made toward the collection and analysis of recent water records for use in checking past plans and making new ones.

### *Sprinkler Irrigation*

Sprinkler irrigation gives promise of making possible the satisfactory irrigation of lands which can be irrigated by surface methods only with great difficulty, if at all. Since certain Bureau projects contain large areas of land of this character, the Bureau initiated a rather thorough investigation of the possibilities. Upon the conclusion of this investigation, an extensive report was prepared. It is titled "Sprinkler Irrigation" and copies are now available to the public. These may be purchased for 20 cents each. Requests should be sent to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Sprinkler systems have been installed by the Bureau of Reclamation on the Columbia Basin project in Washington, the Missouri River Basin project in both North and South Dakota, and the Gila project in Arizona. In these areas many types of systems are being used on a large variety of crops and under a wide range of conditions.

These systems will be operated long enough to provide definite results. The preliminary reports are favorable. Conclusions so far are that sprinkler irrigation is well-established as a successful practice



with most crops and on most arable lands. It does not yet appear to be as economical or otherwise superior to surface methods on lands well-adapted to the latter.

### *Income Taxes From Reclamation Areas*

Income-tax revenues from Federal Reclamation projects areas represent a return on the Federal investment above and in addition to the return of the construction costs by the irrigators and from power revenues.

Estimates have been made of the Federal individual income taxes paid from seven selected project areas, including the territory and town adjacent thereto. These seven Federal Reclamation areas paid almost 63 million dollars of individual income taxes in 1948 and more than 300 million dollars have been paid since 1916, when Federal income taxes were initiated. The construction costs through June 1948 for these projects total about 132 million dollars. Thus, the individual income-tax revenue has already amounted to almost  $2\frac{1}{2}$  times the Federal project costs. The estimates for the individual areas are as follows:

Project area	1948	Total
	<i>Thousands</i>	<i>Thousands</i>
Salt River project area, Arizona.....	\$26,700	\$126,600
Yuma project area, Arizona-California.....	2,600	14,700
Boise project area, Idaho.....	10,850	46,800
Yakima project area, Washington.....	21,500	120,300
Shoshone project area, Wyoming.....	309	2,560
Suri River project area, Montana.....	419	2,543
Lower Yellowstone project area, Montana-North Dakota.....	395	3,435
Total.....	62,773	326,738

The individual income taxes paid from these areas in 1948 amount to about \$50 per irrigated acre, and the total taxes paid since 1916 equal almost \$300 per acre. These tax revenues represent not only taxes paid by irrigation farmers but also the taxes paid by the individuals of the nearby towns and villages whose business or employment depends upon the Reclamation development.

In addition to the above tax revenues, an appropriate share of corporation income taxes and other Federal taxes are either directly or indirectly attributable to business and industrial activity resulting from Reclamation developments. Rough estimates of these additional Federal taxes were made of Maricopa County, Ariz., which represents the Salt River project area. These additional Federal revenues, plus the \$27,000,000 of individual income taxes, would raise the total Federal tax revenue from that area in 1948 to over 60 million dollars. The inclusion in the estimate of all Federal taxes would raise the above figure for the seven project areas to more than 80 million dollars

for 1948 and to more than 400 million dollars for the period 1916-48.

It is roughly estimated that about 1.2 billion dollars of individual income taxes or more than 1.6 billion dollars of all Federal taxes have been paid into the Treasury since 1916 from all Federal Reclamation areas. This compares with a Federal construction cost on these projects of less than 500 million dollars. These estimates do not include projects under construction such as Columbia Basin, Central Valley, and Missouri Basin, nor power developments at Hoover, Fort Peck, Parker, and Davis Dams.

### *Amendatory and New Repayment and Water Service Contracts*

During the fiscal year 1949 notable progress was made in developing standards and procedures for repayment contract negotiations, in sorting out and classifying repayment problems, and in identifying and evaluating basic considerations in determining project payment ability.

Negotiation and execution of repayment contracts for new projects and units of projects exceeded the pace set in fiscal year 1948 to keep up with the accelerated construction program.

Under the authority of the Reclamation Project Act of 1939, investigations were continued into the repayment problems of operating projects. Fiscal year 1949 saw the first substantial harvest of amendatory repayment contracts from investigations initiated in prior years as part of a coordinated program of investigations of the financial and repayment status of operating Reclamation projects. These amendatory contracts are designed to eliminate inequities in existing contracts and put the water users on a sound financial base. In most cases the significant change involved an adjustment of annual payments from an arbitrary basis to one which conforms more closely to the water users' ability to pay based on economic analyses of the projects. Two important principles recognized in most of these contracts are: (a) That water users' ability to make payments varies from year to year—provision of a formula to vary annual payments accordingly, and (b) that unusually large and unforeseen maintenance expenses can throw an otherwise healthy project off-balance—provision made for accumulation of a specific reserve fund to take the shock out of such emergencies.

During fiscal year 1949 a total of 12 amendatory, supplemental, and interim repayment contracts were executed. Six of these were contracts negotiated under provisions of section 7 of the Reclamation Project Act of 1939 and congressional approval obtained through Public Law 56, Eighty-first Congress, first session. These contracts were executed with the following water users' organizations:

Colorado: Uncompahgre Valley Water Users' Association, Uncompahgre project (Public Law 56).

Idaho: Lewiston Orchards irrigation district, Lewiston Orchards project; American Falls Reservoir district No. 2, Minidoka project.

Montana: Bitter Root irrigation district, Bitter Root project (Public Law 56).

Oregon: Shasta View irrigation district, Klamath project (Public Law 56); Jefferson water conservancy district, Deschutes project.

Utah: South Ogden conservation district, Ogden River project.

Washington: Roza irrigation district, Yakima project; Kittitas Reclamation district, Yakima project (Public Law 56); Okanogan irrigation district, Okanogan project (Public Law 56).

Wyoming: Midvale irrigation district, Riverton project; Willwood irrigation district, Shoshone project (Public Law 56).

Section 7 negotiations were completed on six other amendatory contracts which were pending consideration of Congress at the close of the fiscal year as Senate bill 2089 and House bill 5184. These contracts involved the following water users' organizations:

Oregon: Vale Oregon irrigation district, Vale project; Stanfield irrigation district, Umatilla project; Westland irrigation district, Umatilla project.

South Dakota: Belle Fourche irrigation district, Belle Fourche project.

Washington: Prosser irrigation district, Yakima project.

Wyoming: Deaver irrigation district, Shoshone project.

In addition, negotiations were well advanced during fiscal year 1949 on the following:

Idaho: Black Canyon irrigation district, Boise project; Owyhee project (eight districts).

Montana: Malta irrigation district, Milk River project; Glasgow irrigation district, Milk River project; Frenchtown irrigation district, Frenchtown project.

Oregon: Hermiston irrigation district, Umatilla project; West Extension irrigation district, Umatilla project.

Financial adjustment investigations or negotiations for supplemental contracts were initiated or programmed during fiscal year 1949 with 42 more water users' organizations.

In connection with construction of new projects or units of projects, the repayment contract program involved negotiation of (1) water service contracts under the provisions of section 9 (e) of the Reclamation Project Act of 1939, (2) repayment contracts under section 9 (d) of the same act or other comparable legal provisions, and/or (3) combination water service and repayment contracts. Under the combination plan, the cost of the distribution system is contracted for repayment under section 9 (d) and water service is provided under section 9 (e), both in the same contract.

During fiscal year 1949, 15 new repayment contracts were executed with the following water users' organizations:

Arizona: City of Phoenix, Salt River project.

California: Lindsay-Strathmore irrigation district, Central Valley project; Summit City public utility district, Central Valley project; Lindmore irrigation district, Central Valley project; Orange Cove irrigation district, Central Valley project.

Colorado: Conejos water conservancy district, San Luis Valley project. Idaho: Preston, Riverdale, and Mink Creek Canal Co., Preston Bench project; Hayden Lake irrigation district, Rathdrum Prairie project.

Nebraska: Bostwick irrigation district, Missouri River Basin project.

New Mexico: Fort Sumner irrigation district, Fort Sumner project; city of Tucumcari, Tucumcari project.

Montana: Savage irrigation district, Missouri River Basin project.

Oregon: Arnold irrigation district, Deschutes project.

Texas: Lower Colorado River Authority, Marshall Ford project; city of El Paso, Rio Grande project.

At the close of the fiscal year, negotiations had been completed on seven additional new contracts which were pending formal execution by either the water users or the Government. These involved the following water users' organizations:

Arizona: North Gila Valley irrigation district, Gila project.

California: Ivanhoe irrigation district, Central Valley project; Santa Barbara County Water Agency, Santa Barbara County project.

Colorado: North Fork water conservancy district, Paonia project.

North Dakota: City of Dickinson, Heart division, Missouri River Basin project; Heart River irrigation district, Heart division, Missouri River Basin project.

Oregon: Ochoco irrigation district, Deschutes project.

In addition, detailed physical and economic investigations were completed and negotiations well advanced on seven repayment contracts on the Central Valley project, and one on the Frenchman-Cambridge unit of the Missouri Basin project.

### *Rehabilitation and Betterment*

Following the inflexible demands on manpower, equipment, and supplies of World War II, deferment in maintenance of Reclamation and irrigation projects accumulated.

These conditions, coupled with the high postwar costs, have continued almost up to the present time. Consequently, there is a backlog of delayed operation and maintenance work, which, in the best interests of Reclamation projects, cannot be longer delayed.

The cost of performing this backlog of delayed operation and maintenance work is, in practically all cases, beyond the ability of the districts to finance on a current basis, particularly when considered in connection with the relatively high and increasing annual operation and maintenance costs. The cost of the delayed work will be met by the water users by installments over a sufficient number of years.



By placing these projects in good operating condition now, crop losses, which may occur through interruption in water service, are avoided and precious irrigation water is husbanded and conserved through the repair, replacement, improvement, and modernization of the many existing deteriorated and leaky wooden structures and other irrigation features that will bring project irrigation systems and works to an efficient operating condition. It will also result in lower future operation and maintenance costs, and improved service.

An inventory of the rehabilitation and betterment needs of the existing projects was initiated following the war, and an improvement program was started on a limited scale in fiscal year 1949 when Congress appropriated one and a half million dollars for this purpose.

Obviously, only the more urgent needs of a few projects could be undertaken with these funds. In making the appropriation, Congress pointed out that work should be done first on those projects with smaller monetary requirements, and that any remaining funds be used to carry out rehabilitation and betterment on those projects where needs were most urgent.

Projects that have received allotments from the 1949 appropriation and on which rehabilitation is now completed or progressing rapidly are as follows:

Project :		Project :	
Yakima, Wash-----	\$505,750	Riverton, Wyo-----	\$150,000
Bitter Root, Mont-----	40,000	Belle Fourche, S. Dak---	45,000
Orland, Calif-----	135,750	North Platte, Nebr.-Wyo-	500,000
Milk River, Mont-----	73,500	Sun River, Mont-----	20,000
Shoshone, Wyo-----	30,000		
		Total-----	1,500,000

Examples of some of the work performed are as follows: On the Fort Shaw unit of the Sun River project in Montana a 6-mile drainage system was completed, resulting in the rehabilitation of 600 acres of land; work on the replacement of a high-line flume on the Orland project in California was nearing completion. The entire project will benefit from this repair along with the planned replacement of gates for Stony Gorge and East Park Dams, and other general improvements either under way or planned; on the Willwood division of the Shoshone project a new drainage system was nearing completion which would guarantee protection to the entire acreage of the Willwood division, and work was progressing rapidly on the replacement of deteriorated wooden structures that have been in service for over 20 years.

### *Public-Land Openings*

Ever since the first postwar public-land opening was held on the Klamath project in Oregon and California at the close of 1946, Nation-

wide interest has been expressed in the remaining Reclamation public-land units.

While the number of remaining farm units is relatively limited, each time the Bureau announces a new public-land opening, a flood of applications pours in. As an example of the interest shown, an announcement of the homestead drawing held on Minidoka project on March 3, 1949, resulted in requests for 9,601 copies of the public notices, for which 1,112 ex-servicemen qualified and 46 public-land farm units embracing 4,465 acres on the Hunt unit were awarded to lucky veterans.

Five land openings covering public land on four projects and private land on one project were held during the past fiscal year. Inquiries regarding the first three of these (latest figures available at the time the report went to press) exceeded 36,000. The total area involved, public and Government acquired, was 30,728 acres, which were to be divided into 296 farm units. Of these, 846 acres comprising 10 units were Government-acquired lands on the Columbia Basin project in Washington which were sold to prospective settlers. These marked the first lands served by the irrigation facilities of this 1,000,000-acre project. Gradually the number of acres which will be irrigated will increase and the number of units available for resale to individuals will rise accordingly.

The Bureau will have 87,000 acres of this, its biggest individual irrigation project, available for settlement by 1952.

Veterans, under existing law, in all cases involving public lands have a 90-day preference period in which to apply for homestead units.

So far, most veteran homesteaders, at the close of the first year that they have been on the land, have reached the stage where they are building homes, establishing residence on their entries, and have cleared, leveled, and cultivated a portion of their land.

Land openings for the fiscal year 1949 and those scheduled for 1950 are:

Project	Irrigated farms			
	1949		1950	
	Acreage	Units	Acreage	Units
Columbia Basin <sup>1</sup> .....	846	10	1,300	20
Klamath.....	8,283	86		
Minidoka.....	3,618	46		
Shoshone.....	12,070	104		
Riverton.....	5,911	50	14,400	103
Boise-Payette division.....			4,489	50
Yakima Roza.....			723	11
Total.....	30,728	296	20,912	184

<sup>1</sup> These lands are not made available to individuals in the same manner as public lands. The Bureau of Reclamation is acquiring them for resale to prospective homesteaders. The veterans' preference will prevail in the resale of these lands the same as in the case of public lands.

### *Settler Assistance and Land Development*

The Bureau of Reclamation has both a moral and legal responsibility for seeing that settlers on Bureau of Reclamation projects have adequate technical assistance. It is concerned with the financial success and the consequent level of living of farm families on its projects. Furthermore, the Bureau is responsible for obtaining repayments of construction costs allocated to irrigation. It thus cannot escape its responsibility for seeing that everything necessary is done to enable settlers to obtain sufficient income to support their families at an adequate level of living and repay their obligations to the Government.

It is the policy of the Bureau, however, to encourage other agencies—local, State and Federal—to render the maximum amounts of the required assistance which their programs and facilities will permit, with the Bureau rendering only that assistance within the limitation of its program and facilities not rendered by other agencies. Such cooperative relations in settler assistance work may be provided for by either formal or informal agreements.

#### *Cooperation in Settler Assistance*

Settler assistance in many cases is provided for through formal agreement with State colleges of agriculture providing for the employment of assistant county agents who give special assistance to settlers on specified Bureau of Reclamation projects. Under the terms of these agreements the State agricultural extension service employs assistant county agents who are approved by the Bureau of Reclamation, but who work under the supervision of the State extension service. The extension service pays the salaries and office expenses of these assistant county agents, but the Bureau of Reclamation reimburses the extension service for the salaries paid.

Memoranda of understanding are now in effect with the respective State colleges of agriculture providing for the employment of assistant county agents on the following projects: Columbia Basin, Yakima, Owyhee, and Deschutes in Washington; Boise in Idaho; Shoshone, Riverton, and Kendrick in Wyoming; Vale in Oregon; and Milk River in Montana.

Much of the cooperative settler assistance work is provided for through informal agreements with various local, State and Federal agencies. Where several agencies such as the Farmers Home Administration, Soil Conservation Service, Production and Marketing Administration, Rural Electrification Administration, and the extension service are in position to cooperate in settler assistance work, representatives of these agencies formulate a program outlining the type of assistance which each agency is in position to render. This

program usually is prepared in pamphlet form and made available to the settlers in order that they may be informed where to go for the several types of assistance needed. Programs of this type have been carried out on the Shoshone, Minidoka, Yakima, Klamath, Gila, and Yuma projects where farms have been opened to settlement during the past 3 years.

### *Development Farms*

As a part of its settler assistance program the Bureau is conducting development farms for the purpose of demonstrating approved practices in farm layout, irrigation methods, cultural practices, weed control, etc. In all cases the site for such development farms is selected in cooperation with the respective State agricultural colleges. The annual program for the development farm is formulated in cooperation with the State colleges. In some cases, such as on the Columbia Basin Project, the Bureau of Plant Industry and the Soil Conservation Service of the United States Department of Agriculture also cooperate in the development farm program. In most cases a portion of the development farm is set aside for experimental work conducted by the State college and/or Department of Agriculture agencies.

Eight development farms are now in operation. Three of these, namely, Moses Lake, Winchester and Pasco are located on the Columbia Basin project in Washington; one is on the Milk River project in Montana while four are on the Missouri River Basin project, two of which are in North Dakota at Bowbells and Mandan, and two in South Dakota at Huron and Redfield. The program on some of these farms is just getting under way, this being the first year of operation. These demonstrations will be of increasing interest as the program continues. All of the farms, with the exception of the one at Milk River, are located in new areas where irrigation is just getting under way or will be initiated during the next few years. In addition to demonstrating approved irrigation practices the farms will serve to show the results which may be expected from irrigation.

### *Land Development*

In addition to technical assistance as outlined above, settlers on many projects are in need of actual assistance in land development including clearing, rough leveling, and the roughing in of farm irrigation and surface drainage ditches. Such assistance is furnished either by the Bureau itself or through informal agreements with Department of Agriculture agencies. On several projects consisting primarily of privately owned land, arrangements have been made whereby the Soil Conservation Service is giving special assistance to new irrigation farmers in the lay-out of the farm irrigation system, arrangement of



farm fields, clearing and leveling of land and establishing crop rotations. In such cases Bureau of Reclamation representatives cooperate with Soil Conservation Service personnel by supplying them with all available information such as land classification data, topographic maps and engineering plans.

On public land projects the Bureau, in appropriate cases, gives direct assistance on a reimbursable basis in the development of farm units including clearing and rough leveling the land and roughing in of farm irrigation and surface drainage system beyond the farm turn-out. In these cases the individual settlers make application for land development work and agreement is reached as to the nature and extent of the work to be done. The Bureau performs the work with its own equipment and the settler makes payment for this work over a period of years.

### *Weed Control*

One of the most important functions of the Branch of Operation and Maintenance is its weed-control program. Special investigations concerning the water losses and operation and maintenance costs created by weed growths on irrigation distribution and drainage systems and project farms as well as the ditchbanks adjacent thereto were completed this year. These studies provided the basis for a publication entitled "Control of Weeds on Irrigation Systems" which is now available to the public. It might well be termed a "Weed" manual and will be of interest and assistance to every irrigation farmer, county agent and all various State and Federal officials who have to deal with the weed problem in any way. Copies may be obtained for 35 cents by writing to the Superintendent of Documents, United States Government Printing Office, Washington, D. C.

This publication was prepared with the full cooperation of numerous Federal and private irrigation districts, experimental stations, the extension service, and various other Federal, State, and county agencies, along with the Bureau of Plant Industry, and Soils and Agricultural Engineering, Department of Agriculture.

The publication describes the combined investigations which led to the finding of and adapting of new chemical methods for solving various weed problems. One such method developed in the Bureau's Denver Chemical Laboratory has reduced the cost for chemicals to about one-tenth of those previously used for the control of water weeds. These pests often prevent efficient delivery of water, cause excess seepage, necessitate costly dredging of silt deposits and reduce the effectiveness of drains.

The introduction of methods, determined through research, for controlling canal bank weeds and willows has materially reduced maintenance costs and has allowed more extensive control operations. This

is resulting in the more effective elimination of these types of weeds which cause operation problems and transpire an estimated million acre-feet of water per year on Federal and private irrigation projects.

The educational weed-control program carried out for the benefit of project farmers through cooperation with Federal, State, and county organizations is resulting in more effective weed control on croplands. This, in turn, increases farmers' profits and helps protect the Government's investment in Reclamation projects because of the increased repayment ability. In addition to the program for controlling existing weed infestations, special consideration is given to prevention of weed growths, especially on new projects.

The research work, together with a regional weed-control program, is changing weed-control activities from costly, temporary and haphazard guesswork to an orderly program based on scientific methods.

### *Soil and Moisture Conservation Operations*

The Bureau of Reclamation participates in the Department's soil and moisture conservation program, looking toward effective control of accelerated erosion on the 14,500,000 acres of public lands under Reclamation's jurisdiction; protection of its reservoirs, canals, and other irrigation works from siltation; and prevention of water losses detrimental to irrigation projects. Within the limit of the funds made available to the Bureau for these purposes, surveys to delineate our worst problem areas and enable programming of remedial measures to be taken thereon, and an action program for restoring some of the depleted lands and affecting a reduction in water losses, were continued during the past fiscal year. More specifically, the work consists of: (a) Revegetation of overgrazed or denuded lands; (b) the development of water diversions and water spreading devices designed to provide flood irrigation of otherwise dry lands and to eliminate water losses; (c) gully control through planting of trees, shrubs, and grass, together with the construction of check dams and water drops; and (d) other soil and moisture conservation measures for specific conditions.

### *Recreational Use of Reservoirs*

Construction of dams and reservoirs for irrigation and power development provides incidental but very definite benefits to the public through the creation of exceptional recreational opportunities. This is particularly true in the more arid parts of the West where a Bureau of Reclamation reservoir may be the only body of water of any size within hundreds of miles. At the larger reservoirs, such as Lake Mead, on the Colorado River between Arizona and Nevada; Franklin

D. Roosevelt Lake (Grand Coulee) in Washington; and Millerton Lake in California, the administration of recreational facilities is handled for the Bureau by the National Park Service. At certain other reservoirs which are located within National Forest boundaries, recreational facilities are administered by the United States Forest Service. At a few of the smaller reservoirs, the Bureau operates necessary recreational facilities directly and does, in some instances, award concessions for boating and leases for cabin sites. During the past fiscal year, the Bureau has been planning development of a program for optimum recreational use of all of its existing reservoirs, as well as for those under construction or still under investigation. As a prerequisite to achievement of such a program, legislation is required to provide for the expenditure of nonreimbursable funds for development and administration of these recreational resources.

### *Payments to School Districts*

Assistance to school districts, on which an undue financial burden is or will be placed by reason of Federal Reclamation construction activities, was provided under Public Law 835 (general legislation) and Public Law 841 (Interior Department appropriation bill, 1949). The administrative proviso in Public Law 841 authorized payments to school districts, provided the Bureau of Reclamation charge and collect tuition in the amount of \$25 per semester for each dependent of Bureau employees and of contractor employees attending such schools. The requirement for the collection of tuition was contrary in many States to constitutional or statutory provisions of free public schooling. As a consequence, the Bureau during fiscal year 1949 was unable to provide, under this legislation, an appropriate measure of assistance to unduly burdened school districts. Clarifying language included in the Secondary Deficiency Appropriation Act of 1949 places the administration of school payments under the provisions of Public Law 835. At the close of the fiscal year, an order outlining the basic principles for the administration of the act was being prepared for consideration by the Secretary. The proposed order delegates authority to the Commissioner of Reclamation for administration of the Act.

### POWER UTILIZATION

During the past year unsatisfied demands for electric power in the Western States continued to increase. Great emphasis has been placed on the power shortage in the Pacific Northwest. Although this area is still faced with serious shortages, other areas receiving less public attention are experiencing deficiencies in power supply which are equally serious handicaps to their future growth.



Typical power shortage areas are in the Southwestern States and the Missouri River Basin States. Applications for power to be generated at the Davis Dam power plant, located approximately 80 miles downstream from the Hoover power plant, were almost four times the firm capacity output. In the Missouri Basin States of North Dakota, South Dakota, Minnesota, Iowa, Nebraska, and Missouri, the applications for firm power to be generated initially at Fort Randall and Garrison power plants, located on the Missouri River, were almost three times the initial block of firm power. The Western States in general are deficient in electric generating capacity. Development of potential mineral resources have been deferred due to lack of an adequate source of power. Rural cooperatives have either retarded their expansion into new areas or have resorted to the installation of higher cost steam plants to meet the increased demands. Power requirements for irrigation pumping, municipal and industrial uses in Arizona have remained unsatisfied. The entire output of Davis Dam for use in Arizona will be immediately utilized for irrigation pumping and other uses as soon as it is placed in operation in fiscal year 1951. Additional capacity now being installed at the Hoover power plant will also be fully utilized as rapidly as it can be installed. The rapidly increasing population of California which contributes to increased industrial and agricultural expansion continues to place heavy demands on existing power facilities although generating capacity, both public and private, is being installed as rapidly as possible. Power shortages will still threaten for some years to come. Since practically one-half of the installed capacity in the Central Valley is in hydrodevelopments, additional steam capacity is required to assure adequate protection to the power users during the periods of drought and low run-off, as was the experience during 1948.

In all of these areas the development of irrigation pumping, both public and private, has given great impetus to the demand for electric power. Tapping underground sources of water supply for irrigation purposes can well expand the development of arid lands which cannot be supplied directly by canals from water storage structures. The construction of transmission lines into these areas will permit the utilization of lower cost project power for greater expansion of agricultural irrigation developments than has been known heretofore. If the trend in the use of sprinkler irrigation continues, even greater demands will result. The extension of this type of irrigation, which has been confined to relatively small areas in the past, leads to a new concept in the irrigation of arid lands that cannot be economically developed by canal and ditch type irrigation. The sprinkler type of irrigation gives the farmer better control of the application of water, and results in conservation measures which may provide more widespread utilization of the existing water supply.



Greater application of electric power for farm use, coupled with increased industrial activities and the extraction of vast mineral resources by more modern techniques, will continue to place increasingly heavier demands on the power systems of the West. The development of the water resources now going to waste through lack of adequate development can and should be harnessed to assure broad scale development of the western half of the United States.

The Bureau of Reclamation has planned its construction program to meet the increased power requirements, insofar as possible, consistent with the full development of the water resources of the West for irrigation and other purposes.

### *Present Installed Capacity*

During fiscal year 1949 the Bureau of Reclamation had in operation 17 power plants with a total installed capacity of 2,757,400 kilowatts. The increase of 263,000 kilowatts capacity resulted from the addition of one 108,000-kilowatt generating unit at Grand Coulee power plant on the Columbia Basin project, two 75,000-kilowatt units at Shasta power plant on the Central Valley project, the last of 5 units, and a 5,000-kilowatt generating plant at Heart Mountain on the Shoshone project. Power plants operated by others on Reclamation projects total 16, of which 9 were constructed by the Bureau of Reclamation with a total installed capacity of 30,827 kilowatts, and 7 were constructed by others with a total installed capacity of 62,900 kilowatts.

One of the most significant events during fiscal year 1949 was the installation of the first unit in the right powerhouse at Grand Coulee Dam, bringing the total nameplate capacity of the Grand Coulee power plant to 1,100,000 kilowatts, the largest in the world.<sup>1</sup>

### *Additional Capacity Under Construction*

During the fiscal year 1949, 10 new power plants, which will have an ultimate capacity of 892,100 kilowatts, were under construction by the Bureau of Reclamation. Contracts were awarded for turbines and generators for two additional 82,500-kilowatt units at the Hoover power plant of the Boulder Canyon project. Construction was continued on the Keswick Dam and power plant of the Central Valley project which will have an installed capacity of 75,000 kilowatts in three generating units. Upon the completion of this power plant during fiscal year 1950, the Central Valley project will have a total installed capacity of 454,000 kilowatts in the Shasta and Keswick power plants.

<sup>1</sup>This record was surpassed early in fiscal year 1950 when the tenth unit was placed in commercial operation on July 9, 1949, bringing the capacity of the plant to 1,208,000 kilowatts.

The Marys Lake power plant of 8,100 kilowatts capacity and the Estes power plant of 45,000 kilowatts capacity, now under construction on the Colorado-Big Thompson project in Colorado, are scheduled for initial seasonal operation during the spring of 1950. This will bring into operation the initial phase of the eastern slope power development of this project. Work is progressing on the addition of approximately 100,000 kilowatts of capacity to develop the power drop between the Estes power plant and the Foothills storage system of the project. This capacity is scheduled for initial operation in fiscal year 1953.

On the Missouri Basin project, the Kortes power plant of 36,000 kilowatts capacity near Seminoe Dam in Wyoming is scheduled for initial operation during the spring of 1950. Work is progressing on the completion of Boysen Dam and power plant in the Big Horn Basin in Wyoming. The power plant of 15,000-kilowatt capacity is scheduled for operation in fiscal year 1952. Davis Dam and power plant, located on the Colorado River, will have an installed capacity of 225,000 kilowatts and is scheduled for operation in the spring or early summer of 1951.

The power plant at Anderson Ranch Dam in Idaho will have an initial installed capacity of 27,000 kilowatts and is scheduled for operation in the spring of 1950. The Hungry Horse Dam and power plant of 285,000 kilowatts, now under construction on the South Fork of Flathead River in Montana, is scheduled for initial operation in October 1952; the second unit in operation by December 1952. The last two units are scheduled for operation in August and November of 1953.

The Canyon Ferry Dam in Montana is now under construction. The power plant is scheduled for initial operation in 1954, although restrictive language in the appropriations bill for fiscal year 1949 prevented the Bureau of Reclamation from initiating work on the design and purchase of the necessary generating and electrical equipment. On the Fort Peck project in Montana, the Corps of Engineers is progressing on the installation of a third unit which will have a capacity of 35,000 kilowatts. Operation is scheduled for fiscal year 1952. The Corps of Engineers, Department of the Army, has under active construction the Garrison Dam in North Dakota and the Fort Randall Dam in South Dakota. Although power requirements of the area indicate the immediate need for generating capacity, the initial operating schedule for Garrison and Fort Randall power plants are tentatively 160,000 kilowatts capacity in fiscal year 1953 at Fort Randall, and 240,000 kilowatts in fiscal year 1954 at Garrison. Actual progress which can be made is contingent upon appropriations to meet these schedules. The schedule of the power plants in various stages of construction but not in full operating status are shown in table 9.

TABLE 9.—*Hydroelectric plants on Reclamation projects—operating, under construction, or authorized as of June 30, 1919*

CONSTRUCTED AND OPERATED BY BUREAU OF RECLAMATION

State	Project	Name of plant	Year of initial operation	Present nameplate capacity (kilowatts)	Ultimate nameplate capacity (kilowatts)	Present number of generators and capacities (kilowatts)	Ultimate number of generators and capacities (kilowatts)
Arizona-Nevada	Boulder Canyon	Hoover <sup>1</sup>	1936	1,034,800	1,332,300	Twelve 82,500; one 40,000; two 2,400	Fifteen 82,500; one 40,000; one 50,000; two 2,400
Arizona-California	Parker	Parker	1912	120,000	120,000	Four 30,000	Four 30,000
California	Central Valley	Stasia	1914	379,000	379,000	Five 75,000; two 2,000	Five 75,000; two 2,000
Do	Yuma	Shoshone Drop	1926	1,600	1,600	Two 800	Two 800
Colorado	Colorado-Big Thompson	Green Mountain	1913	21,600	21,600	Two 10,800	Two 10,800
Idaho	Boise	Boise Diversion	1912	1,500	1,500	Three 500	Three 500
Do	do	Black Canyon	1925	8,000	8,000	Two 4,000	Two 4,000
Do	Minidoka	Minidoka	1909	13,400	13,400	One 5,000; one 2,400; five 1,200	One 5,000; one 2,400; five 1,200
Wyoming	North Platte	Guernsey	1927	4,800	4,800	Two 2,400; two 300	Two 2,400
Do	do	Ingile	1919	1,400	1,400	Two 400; two 300	Two 400; two 300
New Mexico	Rio Grande	Elephant Butte	1910	24,300	24,300	Three 8,100	Three 8,100
Washington	Columbia	Grand Coulee <sup>2</sup>	1911	1,100,000	1,974,000	Ten 108,000; 3 two 10,000	Eleven 108,000; 3 three 10,000
Do	Yakima	Frosser <sup>4</sup>	1932	2,400	2,400	One 2,400	One 2,400
W,oming	Kendrick	Seminole	1939	32,400	32,400	Three 10,800	Three 10,800
Do	Riverton	Pilot Butte	1915	1,600	1,600	Two 800	Two 800
Do	Shoshone	Heart Mountain	1918	5,000	5,000	One 5,000	One 5,000
Do	do	Shoshone	1922	5,500	5,500	One 4,000; two 800	One 4,000; two 800
Subtotal				2,757,400	3,926,500		

CONSTRUCTED BY BUREAU OF RECLAMATION; OPERATED BY OTHERS

Arizona	Salt River	Roosevelt	1909	15,400	15,400	Five 1,080; one 4,000; one 6,000	Five 1,080; one 4,000; one 6,000
Do	do	Arizona Falls <sup>5</sup>	1913	850	850	Two 425	Two 425
Do	do	Cross Cut <sup>3</sup>	1914	5,100	5,100	One 3,000; three 700	One 3,000; three 700
Do	do	S, Consolidated <sup>3</sup>	1912	1,600	1,600	Two 800	Two 800
Colorado	Grand Valley	Grand Valley (Pallisades)	1932	3,000	3,000	Two 1,500	Two 1,500
Nevada	Newlands	Lahontan	1911	1,640	1,920	Two 500; one 640	Three 640
Oregon	Deschutes	Cove <sup>6</sup>	1946	1,500	1,500	One 1,500	One 1,500
Utah	Strawberry Valley	Spanish Fork <sup>7</sup>	1908	1,550	1,550	Two 450; one 250; one 400	Two 450; one 250; one 400
Washington	Yakima	Rocky Ford	1916	187	187	One 187	One 187
Subtotal				30,827	31,107		

See footnotes at end of table.

TABLE 9.—*Hydroelectric plants on Reclamation projects—operating, under construction, or authorized as of June 30, 1919*—Continued  
CONSTRUCTED AND OPERATED BY WATER USERS' ORGANIZATIONS

State	Project	Name of plant	Year of initial operation	Present nameplate capacity (kilowatts)	Ultimate nameplate capacity (kilowatts)	Present number of generators and capacities (kilowatts)	Ultimate number of generators and capacities (kilowatts)
Arizona	Salt River	Chandler s	1919	600	600	One 600	One 600
Do	do	Horse Mesa s	1927	30,000	30,000	Three 10,000	Three 10,000
Do	do	Mormon Flat s	1926	7,000	7,000	One 7,000	One 7,000
Do	do	Stewart Mountain s	1930	10,400	10,400	One 10,400	One 10,400
California	All-American	Drop No. 3 g	1941	4,800	9,600	One 4,800	Two 4,800
Do	do	Drop No. 4 g	1941	9,600	19,200	One 9,600	Two 9,600
Oregon	Klamath	"C," Canal Drop 10	1938	500	500	One 500	One 500
Subtotal				62,900	77,300		
CONSTRUCTED AND OPERATED BY CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY; POWER MARKETING BY BUREAU OF RECLAMATION							
Montana	Fort Peck	Fort Peck	1943	50,000	85,000	One 35,000; one 15,000	Two 35,000; one 15,000
UNDER CONSTRUCTION BY BUREAU OF RECLAMATION							
Arizona-Nevada	Davis	Davis	1951	0	225,000	0	Five 45,000
California	Central Valley	Keswick	1950	0	75,000	0	Three 25,000
Colorado	Colorado-Big Thompson	Estes	1950	0	45,000	0	Three 15,000
Do	do	Marys Lake	1950	0	8,100	0	One 8,100
Idaho	Boise	Anderson Ranch	1950 11	0	12 40,500	0	Three 13,500
Do	Pallisades	Pallisades	1954	0	13 112,500	0	Five 22,500
Montana	Missouri Basin	Canyon Ferry u	1954	0	50,000	0	Three 16,667
Do	Hungry Horse	Hungry Horse	1952	0	285,000	0	Four 71,250
Wyoming	Missouri Basin	Boysen	1952	0	15,000	0	Two 7,500
Do	do	Kortes	1950	0	36,000	0	Three 12,000
Subtotal				0	892,100		
UNDER CONSTRUCTION BY CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY; POWER TO BE MARKETING BY BUREAU OF RECLAMATION							
North Dakota	Missouri Basin	Garrison	1954	0	400,000	0	Five 80,000
South Dakota	do	Fort Randall	1953	0	320,000	0	Eight 40,000
Subtotal				0	720,000		



## AUTHORIZED TO BE CONSTRUCTED BY BUREAU OF RECLAMATION

Colorado	Colorado-Big Thompson	Quillan	1953	0	28,500	0	Three 9,500.
Do	do	Cottonwood	1953	0	11,500	0	Two 5,750.
Do	do	Rattlesnake	1953	0	13,500	0	Two 6,750.
Do	do	Flairon	1953	0	41,000	0	Three 7,000; two 10,000.
Do	do	Big Thompson	1953	0	6,700	0	One 6,700.
Montana	Missouri Basin	Angostura	1953	0	1,560	0	Two 780.
Do	do	Lower Marias (Kenil)	1953	0	3,000	0	Three 1,000.
Do	do	Lyon	1959	0	24,000	0	Three 8,000.
Do	do	Portage	1961	0	50,000	0	Three 16,667.
Do	do	Yellowtail	1954	0	20,000	0	Two 10,000.
Do	do	Harlan	1954	0	17,200,000	0	Three 40,000.
Do	do	Crosby	1954	0	1,200	0	One 1,200.
Do	do	Des Laes	1959	0	13,70,000	0	Four 17,500.
Do	do	Miller Drop	1959	0	13,70,000	0	Four 17,500.
Do	do	Roza	1953	0	180,000	0	Four 45,000.
Do	do	Chandler	1954	0	10,000	0	Two 5,000.
Do	do	Bald Ridge	1954	0	12,000	0	Two 6,000.
Do	do	Hunter Mountain	1960	0	30,000	0	Three 10,000.
Do	do	Sunlight	1960	0	12,000	0	Two 6,000.
Do	do	Thief Creek	1957	0	20,000	0	Two 10,000.
Do	do	Tongue River	1957	0	60,000	0	Three 20,000.
Do	do			0	25,000	0	Two 12,500.
Subtotal				0	809,960		

## AUTHORIZED TO BE CONSTRUCTED BY CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY; POWER TO BE MARKETED BY BUREAU OF RECLAMATION

South Dakota	Missouri Basin	Big Bend	1959	0	13 120,000	0	Six 20,000.
Do	do	Gavins Point	1953	0	13 20,000	0	Two 10,000.
Do	do	Oahe	1959	0	13 490,000	0	Seven 70,000.
Subtotal				0	630,000		
Total (from this tabulation)				2,801,127	4 7,171,967		
Total (with Grand Coulee units figured at 120,000 kilowatts)				3,021,127	4 7,387,967		

<sup>1</sup> Power plant units operated by power allottees under agency contract.<sup>2</sup> Power marketed by Bonneville Power Administration.<sup>3</sup> Main units with a nameplate rating at 108,000 kilowatts have continuous operating capacity of 120,000 kilowatts.<sup>4</sup> Prosner will be removed when Chandler is built.<sup>5</sup> Powerplant constructed by Bureau of Reclamation with Salt River Valley Water Users' Association funds.<sup>6</sup> Unit No. 3 installed in Pacific Power and Light Company's plant.<sup>7</sup> Three plants: (a) Spanish Fork (upper); (b) Spanish Fork (lower); (c) Payson.<sup>8</sup> Constructed and operated by Salt River Valley Water Users' Association.<sup>9</sup> Constructed and operated by Imperial Irrigation District.<sup>10</sup> Constructed and operated by Enterprise Irrigation District.<sup>11</sup> First two units completed.<sup>12</sup> 27,000 kilowatts presently authorized.<sup>13</sup> Capacity is tentative only, and may be revised.<sup>14</sup> Powerplant foundations only.<sup>15</sup> Construction deferred due to present high cost.<sup>16</sup> Seasonal output to be used for irrigation pumping.<sup>17</sup> Increase of present tentative capacity of 120,000 kilowatts to 200,000 kilowatts is now under study.

Additional authorized plants not presently under construction will consist of 22 power plants with a total installed capacity of 809,960 kilowatts. Additional power plants authorized for construction by the Corps of Engineers, from which the Bureau of Reclamation is responsible for marketing power, will total 630,000 kilowatts in three plants on the Missouri River.

### *Transmission Lines*

At the close of fiscal year 1949, the Bureau of Reclamation had approximately 3,300 miles of high-voltage transmission lines in operation. During the fiscal year the principal lines placed in operation were approximately 25 miles of 230-kilovolt transmission line from Shasta power plant to the Shasta substation of the Pacific Gas & Electric Co.; 72 miles of 115-kilovolt line from Elephant Butte to Sorocco, N. M., on the Rio Grande project; initial operation at 33-kilovolt of the 100-mile Fort Peck to Bainville, Mont., section of the 115-kilovolt Fort Peck-Williston line; and initial operation of the 37-mile Beulah to Garrison section of the Williston-Garrison 115-kilovolt transmission line. Approximately 2,000 miles of additional high-voltage transmission lines were under construction during fiscal year 1949. These additional lines will be placed in operation during the next 2 or 3 years.

### *Electric Energy Sales*

The Bureau of Reclamation operated 17 power plants during the fiscal year, and, under the provisions of the Fort Peck Project Act of 1938, marketed the output of the Fort Peck power plant operated by the Corps of Engineers. During this year the sales of electric energy, not including transactions between Bureau projects, totaled approximately 18,144,000,000 kilowatt-hours. The revenue from these sales reached an all-time high of approximately \$32,000,000. This compares to a total of sales of 15,191,150,147 kilowatt-hours, and revenues of \$25,342,811 during fiscal year 1948. Revenues for fiscal year 1949 exceeded previous estimates by approximately \$6,000,000. A large part of this increase in revenue resulted from heavy demands for electric power, and integration of the Bureau hydroelectric systems with other existing systems to obtain maximum power production from the water resources. A summary of power sales and revenues by projects is shown in table 10.

TABLE 10.—*United States Department of the Interior, Bureau of Reclamation power systems, power sales and revenues by projects, fiscal year ending June 30, 1949*<sup>1</sup>

Project	Sales of electric energy (kilowatt-hours)	Revenues from sales of electric energy	Project	Sales of electric energy (kilowatt-hours)	Revenues from sales of electric energy
Region I:			Region VI:		
Boise.....	38, 085, 432	\$44, 504	Fort Peck.....	327, 261, 644	\$950, 392
Columbia Basin.....	9, 108, 463, 600	9, 175, 034	Riverton.....	28, 237, 924	189, 538
Minidoka.....	120, 503, 022	430, 779	Shoshone.....	57, 246, 622	314, 886
Yakima.....	21, 791, 008	58, 229	Region VII:		
Region II: Central Valley.....	1, 624, 006, 921	6, 523, 222	North Platte.....	38, 959, 104	419, 890
Region III:			Kendrick.....	109, 710, 598	558, 938
Boulder Canyon.....	5, 668, 155, 482	9, 259, 599	Colorado-Big Thompson.....	80, 515, 874	697, 706
Parker.....	837, 348, 212	2, 985, 906			
Yuma.....	9, 216, 184	42, 517			
Region V: Rio Grande.....	74, 891, 173	388, 525	Total.....	18, 144, 392, 800	32, 039, 665

<sup>1</sup> Does not include energy sales and revenues in transactions between Bureau projects.

NOTE.—Data shown are preliminary and are subject to revisions.

### Power Contracts

During fiscal year 1949, power was delivered to numerous major and minor users of power. Major deliveries were made to 26 municipalities, 7 State government agencies, 52 rural electric cooperatives, 3 Federal agencies, 45 public authorities, 24 commercial and industrial users, and 37 privately owned utilities. A summary by classification of customers for the 12 months ending June 30, 1949, is contained in table 11.

TABLE 11.—*Summary by classification of customers for 12 months ending June 30, 1949*<sup>1</sup>

	Number of customers	Sales of electric energy (kilowatt-hours)	Revenues from sales of electric energy
Privately owned utilities.....	37	4, 641, 092, 434	\$12, 964, 070
Municipal utilities.....	26	3, 084, 206, 424	5, 063, 509
State government utilities.....	7	609, 415, 194	1, 974, 875
Cooperative utilities.....	52	88, 483, 666	659, 209
Other Federal utilities.....	3	9, 111, 691, 622	9, 272, 521
Residential and domestic.....	484	5, 019, 537	33, 402
Rural.....	4	72, 771	868
Commercial and industrial.....	24	61, 302, 343	400, 642
Public authorities.....	45	445, 482, 100	1, 445, 014
Interdepartmental.....	28	97, 611, 349	225, 335
Other sales.....	1	15, 360	220
Total, all customers.....		18, 144, 392, 800	32, 039, 665

<sup>1</sup> Does not include energy sales and revenues in transactions between Bureau projects.

During the year, 80 contracts for delivery of power were executed. These include 7 contracts with irrigation districts, 5 with other Federal bureaus and agencies, 2 with public power districts, 2 with State authorities, 17 with private utilities, 24 with rural electric cooperatives, 16 with municipalities, and 7 with other customers. A number of these contracts were renewals of expiring contracts or revisions

resulting from changed conditions. The decrease in commercial and industrial customers shown in table 11, from 45 last year to 24 this year, resulted from consolidation of accounts. They occurred principally on the Rio Grande project where 21 accounts were merged into 2 accounts.

The contract between the Bureau and Montana-Dakota Utilities Co. was supplemented during the year to provide for service by the Bureau to additional preference customers, especially cooperatives in the Dakota system of the company. The wheeling arrangement, now in effect between Montana-Dakota Utilities Co. and the Bureau, has been instrumental in providing electric service to cooperatives not directly connected to Bureau transmission facilities. Similar wheeling arrangements are now under negotiation with other utilities in the Missouri River Basin area.

The Bureau of Reclamation, at the beginning of fiscal year 1949, had 114 contracts for delivery of power under negotiation. These include 58 with rural electric cooperatives, 16 with private utilities, 15 with municipalities, 9 with irrigation districts, 4 with State authorities, 4 with Federal agencies and bureaus, and 8 with other customers. A number of these are to renew existing contracts or to revise them to reflect changed conditions. Included in the above summary of contracts under negotiation are contracts with 20 cooperatives and irrigation districts to be served through arrangement with the Montana-Dakota Utilities Co. A large number of contracts under negotiation are for future power deliveries at such time as additional generating capacity now under construction is placed in operation.

## PROJECT PLANNING

### *Investigations and Planning*

Three events of major significance to the planning of water resource development occurred in the past fiscal year. Complete agreement between the Bureau of Reclamation and the Corps of Engineers was reached on a coordinated plan of water resource development for the Columbia River Basin and upon principles and responsibilities to guide the accomplishment of this plan. A compact between the States of the Upper Colorado River Basin on the division of their share of Colorado River water was consummated, thus clearing the way for development of specific plans for utilizing the water resources in the Upper Basin States. The Bureau of Reclamation initiated a program of water resource development in Alaska. All three of these events are ones that will lead to important water resource development programs over the next half-century or more.



Elsewhere the investigation and planning of water resource development proceeded along anticipated lines. Each succeeding year, however, emphasizes that investigation and planning are becoming more and more involved. During the first few decades of water development in the West, the inexpensive, easily developed projects were almost completely exhausted largely by privately financed development. The remaining potentials are, in the main, long-range basin developments of exceeding complexity which only the Federal Government has the ability to finance. A reduction in the funds appropriated for the planning program was made by the Congress in fiscal year 1948, and this reduced program was necessarily continued through fiscal year 1949 not only because of lack of ample funds but because of personnel and administrative restrictions placed on the Bureau by the Congress. Good progress was made on those investigations which could be financed during the year.

### *Comprehensive Basin Survey Reports*

The most significant development in basin planning during the fiscal year was the coordination of the plans of the Bureau of Reclamation and of the Corps of Engineers for the comprehensive development of the Columbia River Basin, formalized by the "Agreement on Principles and Responsibilities for the Comprehensive Plan of Development—Columbia River Basin" signed on April 11, 1949, by the Secretary of the Interior and the Commissioner of Reclamation and by the Secretary of the Army and the Chief of Engineers. At the end of the year there was pending before the Congress legislation which would authorize a program to develop water and related resources of the Columbia River Basin in accordance with this agreement and with the recommendations of the "308 Review Report" of the Corps of Engineers, Department of the Army, and the "Report on Comprehensive Plan of Development of the Water and Related Resources of the Columbia River Basin" of the Bureau of Reclamation, Department of the Interior. The two reports supplement each other. Together these reports contain both long-range plans for the ultimate complete control and conservation of the basin's water resources, and recommendations for authorization of an immediate program of construction as the next step towards full development. The plans also provide for the integration of related programs of land and other resource improvements that are the primary responsibilities of other Federal and State agencies.

At the end of the fiscal year the report on the Central Valley Basin was under review by the Bureau of the Budget. Later, upon completion of this review, the report was transmitted to the Congress.

*New Project Authorized*

A project planning report was completed on the Solano County project in California. The project was authorized for construction by a finding of feasibility by the Secretary of the Interior. Also, the enlargement of the power plant at Grand Coulee Dam of the Columbia Basin project in Washington to include additional power units R-7, R-8, and R-9 was authorized by a finding of feasibility by the Secretary in a planning report.

*Other Project Planning Reports*

Project planning reports on The Dalles project, west unit, in Oregon and the Central Arizona project in Arizona, New Mexico, and Utah were submitted to the Congress by the Secretary with recommendations for favorable action on authorization of the projects. Reports on the Snowflake and Chino Valley projects in Arizona were forwarded to the Congress also, but without recommendation for authorization at this time. A similar report on the Emery County project in Utah was forwarded to the President.

At the end of the fiscal year, reports on the Lyman project in Wyoming, the Vermejo project in New Mexico and the Big Creek project in Texas, were under review by the affected States and other agencies.

Supplemental reports supporting the findings in the Bureau's report on the Columbia River Basin were prepared on the following projects which are proposed for authorization in the next step in the development of the basin:

Bitterroot Valley project, Mont.  
 Cambridge Bench project, Idaho.  
 Canby project, Oreg.  
 Council project, Idaho.  
 Crooked River project, Oreg.  
 Hells Canyon project, Idaho, Oreg.

Mountain Home project, Idaho.  
 Upper Star Valley project, Wyoming,  
 Idaho.  
 Vale project, Bully Creek extension,  
 Oreg.

*River Compacts*

A second important development in basin planning was the consummation of a compact between the States on the use of the waters of the Upper Colorado River. This compact entered into by the States of Colorado, Utah, New Mexico, Wyoming, and Arizona was approved by the President on May 6, 1949, and became Public Law 37 of the Eighty-first Congress. For years the lack of this Compact prevented the formulation of the comprehensive plan for the complete and efficient utilization of the waters of the Upper Colorado River. With the situation with respect to water rights thus clarified, it is now pos-

sible to proceed with the planning for the comprehensive development of this basin.

A compact between the States of Colorado and Kansas on the Arkansas River was completed and was approved as Public Law 82, Eighty-first Congress, and another compact on the Pecos River was completed by the States of New Mexico and Texas and approved as Public Law 91, Eighty-first Congress.

### *Alaska Investigations*

In the appropriation act for fiscal year 1949, the Congress made an initial appropriation of \$150,000 to the Bureau of Reclamation for investigations in Alaska relating to water power resources as a basis for legislation. Field investigations were started immediately and the Bureau completed a report on the Eklutna project which was transmitted to the President. It also made a general preliminary reconnaissance and report on the water resources of the Territory of Alaska. The Bureau is completing another report on the Lake Dorothy project, but so far only the surface has been scratched in investigating the possibilities of water resources development in the Territory.

The reconnaissance report points out that there has been virtually no organized effort on the part of any agency, public or private, to develop or stimulate expansion of industry, community life and agriculture in Alaska. This report reveals that there is a need and that there are vast opportunities for development in the Territory. For example, although only the major streams have been reconnoitered, already the Bureau's engineers have found hydroelectric power sites which could produce nearly 50 billion kilowatt-hours of energy annually. This is equal to nearly one-fifth of the entire electric power production by utilities in the United States last year.

Development of the natural resources of Alaska is essential. It will provide impetus for the industrial expansion and settlement of Alaska and in the ultimate sense, for the defense of the Territory by the prudent development of power, irrigation, and drainage projects. However, before a public works program of any size could go ahead in Alaska, considerable investigation work will have to be undertaken and completed.

### *Hydrology*

In addition to the normal hydrologic studies required for planning and operation of projects the Bureau of Reclamation participated with other Federal agencies through the Federal Inter-Agency River Basin Committee in publishing a revised edition of river basin maps

showing hydrologic installations in the United States, an inventory of sediment sampling stations in the United States and quality of water stations in the 17 western States and the Proceedings of the Federal Inter-Agency Sedimentation Conference.

Sedimentation studies were made in connection with specific investigations, particularly in the Middle Loup River Basin in Nebraska, the Colorado River Basin in Arizona, Colorado and Utah; the Angostura unit and the Moorhead unit of the Missouri River Basin project, the North Platte project and the Lower Platte River Basin. Sedimentation surveys were made of Guernsey, Altus, Tongue, Buffalo Bill, and Mason Reservoirs and Sheridan County Lake. The survey of Lake Mead in cooperation with the Geological Survey and the Navy was completed.

These surveys provided valuable information needed to develop the means for attaining maximum efficiency in the operation of projects concerned and to aid in preparation of plans for projected work.

In the instance of Guernsey Reservoir on North Platte River, Wyo., for example, the survey disclosed that the storage capacity of the reservoir was reduced 33.41 percent by sedimentation representing the loss of 24,660 acre-feet, which at \$25.48 per acre-foot of storage capacity means a loss of \$628,336.80 against an investment of \$1,881,036, or about 30 percent. For Tongue Reservoir on the Tongue River, Wyo., the survey disclosed that sedimentation had reduced storage capacity 4.2 percent representing a loss of 3,071 acre-feet, which at \$17.93 per acre-foot of storage capacity means a loss of \$55,000 against an investment of \$1,300,000 or in excess of 4 percent.

The research being conducted by the Army, Navy, and Weather Bureau on artificial precipitation was studied by the Bureau of Reclamation. Liaison on this work with those agencies was established enabling the Bureau to keep abreast of the research of those agencies, and to be advised on the work to the extent that it may effect western water supplies.

### *International Investigations*

As a result of negotiations between Canada and the United States, the two governments jointly sent a reference to the International Joint Commission requesting that a study and advisory findings be made of the present and future uses, and apportionments between the two countries, of certain international streams between the continental divide on the west to and including the Red River of the North on the east.

The International Engineering Boards with their Field Engineering Committee, which included representatives of the Bureau of Reclamation, conducted field studies of available water supplies, the



present water uses, and potential future water uses in the vicinity of the international boundary. These determinations are required under the reference as one basis upon which an apportionment between the two countries of the waters under the reference may be recommended.

## PROGRAMS AND FINANCE

### *New Accounting System*

After an exhaustive inquiry by the Congress, a Senate Committee emphasized the importance of an early revision of the Bureau's accounting system and related procedures, and instructed the Comptroller General of the United States to work out with the Secretary of the Interior an improvement of the Bureau's accounting system. In accordance with these instructions, representatives of the Bureau of Reclamation and the General Accounting Office have revised the Bureau's accounting system and related procedures.

The Bureau of Reclamation as a governmental agency is required to keep accounts to meet the accounting and reporting requirements of the Congress, the General Accounting Office, the Treasury, and the Bureau of the Budget. As a producer and distributor of electric power, it is also required by law to keep accounts to meet the accounting and reporting requirements of the Federal Power Commission, which include annual financial statements covering each year's operations of all power projects.

As distinguished from the statutory and regulatory requirements discussed above, other important purposes are:

To provide control of expenditures and application of funds for all activities through a coordinated system of accounting, programming, and budgetary reports.

To provide standard and uniform financial statements and reports to summarize the information which is required regularly by the Bureau's administrators for managerial purposes.

To provide for the recording of financial information in a consistent and uniform manner to make possible the compilation of data in such form as to be comparable with similar data for other periods and other projects.

To facilitate the determination of fidelity of persons administering public funds and properties.

Most of the principles used in commercial accounting are incorporated in the Bureau's system of accounts. The Bureau, as a governmental agency, is financed from appropriated funds and is required also to use many of the accounting principles developed for Government, particularly those that relate to budgetary procedures. Cer-

tain other principles that are peculiar to the Bureau stem from reclamation laws. The following are essential principles of the system:

The project is considered as the "accounting entity" or the level of operation for the maintenance of the books of accounts. Each project is considered as a basic unit and accounts for its assets, liabilities, income, expenses, the amount appropriated to the project, and the investment of the Government and facility users.

A decentralized system of accounting has been established which results in independent accounts being kept by each project. The control of funds is provided by means of branch office accounts maintained in the Commissioner's office and regional offices.

Properties are accounted for at original cost. Cost accounts for operation and maintenance are on an "applied" or "consumed" basis. Elements of such costs are assigned in the accounting period to which such costs are applicable regardless of the sources of such charges or the time when obligations are incurred or expenditures made.

A system of budgetary control is integrated with the general ledger accounts by the use of subaccounts and special accounting procedures. The budgetary accounts reflect the unliquidated obligations, accrued expenditures, and the unobligated balances of appropriated funds.

The classification of accounts is uniform for programing, budgeting, accounting, and subsequent reporting.

Expenditures are accounted for on the accrual basis, i. e., expenditures are recorded in the allotment accounts when work or services are performed of materials and property received, regardless of whether the vouchers for such items have been paid.

The system of accounts effectively distinguishes between capital and expense.

The following accounts have already been incorporated in the Bureau's new accounting system: General ledger accounts, plant in service accounts, construction work in progress accounts, allotment ledger accounts, electric operating income and expense accounts, and irrigation operation and maintenance accounts.

The general ledger accounts are the basis of the new accounting system, and include all of the control accounts required for the preparation of balance sheets and supporting schedules. The general ledger accounts are so designed that any type of appropriation can be accounted for irrespective of whether the money is to be spent for construction, investigations, operation and maintenance, or other type of activities. Fund control accounts are provided which interlock all offices (project, regional and Washington). These are termed reciprocal accounts and conform to accepted principles of branch-office accounting. The following types of general ledger accounts have been prescribed:

The Commissioner's fund-control accounts control the distribution of appropriated funds and repayments (refunds and reimbursements). A record is kept of all unappropriated funds administered by the Bureau of Reclamation. The accounts also provide the controls which are necessary with the Treasury Department and the Chief Disbursing Officer. The Commissioner allocates the appropriated funds to the various regions for allotment by them to the projects and/or activities. Funds for disbursements are transferred within the amounts allocated to the project and regional offices.

The regional fund control accounts control the distribution of allocated funds which are allotted to the projects and/or activities. The accounts also reflect any unfunded balances due the projects under any appropriation or allotment. The Commissioner's Office of Programs and Finance also maintains regional-type accounts for salaries and expenses, centralized project activities, investigations, and all other Bureau-wide appropriations except Missouri River Basin, rehabilitation and betterment, and the emergency fund.

Several types of general ledger accounts have been prescribed for the projects or Bureau activities, as follows: Project proprietary and fund accounts (for construction and operation and maintenance activities), Commissioner's Washington and Denver Offices and regional offices financed from direct salaries and expenses appropriation, Commissioner's Denver offices financed from transfers to the salaries and expenses appropriation, centralized project activities in regional offices, and investigations. It was considered necessary to prescribe individual types of accounts for projects and activities because the project is the accounting entity. Each accounts for its assets, liabilities, obligations and expenditures as well as reflects the Government's investment, income and expenses, and its general financial condition.

Several groups of subsidiary accounts are required which furnish detailed information. The essential accounts prescribed are: Plant in service accounts: Multipurpose plant, irrigation plant, electric plant, municipal water, other plant; construction work in progress (cost accounts); clearing accounts; allotment accounts; operating income and expense accounts—electric; operating income and expense accounts—irrigation; and other.

Classification of expenditures (on an accrual basis) between capital and expense is important because it has a vital bearing on the financial statements, and eventually influences charges for water and power. Accordingly, plant and property acquired, as well as additions and betterments, whether by construction or purchase and regardless of the source of funds are capitalized at actual cost to the Government and classified to the appropriate plant in service accounts on the basis of the physical characteristics.



Reclamation laws require that the investment in a project be allocated to the various purposes or functions authorized to be carried on by the project. Such allocations are necessary for rate-making purposes, establishing repayment contracts, determining interest payable to the Government on power facilities, pay-out schedules and for the determination of the total reimbursable and nonreimbursable costs of the project.

To assure conformance of work in progress with the Commissioner's approved program and the intent of the Congress in appropriating funds, subsidiary construction cost accounts and a work-order system have been prescribed to accumulate cost data by identified and classes of properties. Control is exercised over construction expenditures through the work-order system as major changes in the program must be approved by the Commissioner of the Bureau.

Clearing accounts have been prescribed to accomplish two important purposes: (1) to accumulate costs by activities which benefit several functions, features or units of a project and which must be distributed on the basis of benefits received by each, and (2) to accumulate costs which cannot be assigned to the appropriate function at the time the expenditure is incurred.

The allotment accounts are designed and maintained for one basic purpose, which is to make certain that the Bureau conforms with the Antideficiency Act. Departments are prohibited from incurring obligations and spending more than has been appropriated. All transactions involving expenditures or obligating the Bureau for future expenditures are recorded on a current basis. The unencumbered and unobligated allotments, unliquidated obligations, and expended and unexpended balances of the allotments are also shown.

The operating income and expense accounts, electric, are designed to show the amount of money earned by the projects from furnishing electricity and services incidental thereto. The expense accounts show the detailed cost of furnishing these services. The classification of accounts conforms to the system prescribed by the Federal Power Commission.

The operating income and expense accounts, irrigation, are designed to show the different types of income from furnishing water under contracts and miscellaneous receipts incidental to irrigation operations. The expense accounts show the detailed cost of furnishing the irrigation water. The classification of accounts is set up on the same general principal as is provided for under electric-operating expenses.

Separate accounts are established for: (1) operation and maintenance charges financed by advances: (2) operations under section 9 (e) of the 1939 Reclamation Law where the annual rates for service is to return the cost of operation and maintenance and the construction costs over the period of the water contracts; and (3) for operations paid



from Reclamation Fund appropriations and reimbursed by water users.

Other subsidiary accounts are established for such items as repayment contracts, contributions in aid of construction, and special deposits where the detail work involved justifies subsidiary accounts.

All financial and operating statements, including the fund statements, are prepared from the general ledger and related subsidiary accounts. The basic financial statements and reports which will be submitted either monthly, semiannually, or annually are: Balance sheet, income and expense statements, construction work in progress statement, plant in service statements, report on status of appropriations, analysis of operating surplus or deficit, and sources and application of funds statement. These statements constitute the source of all financial data. Any other financial information shall be certified correct by the regional programs and finance officers.

The new accounting system has been completely installed in all projects of the Bureau of Reclamation as of June 30, 1949, with the exception of the work-order system, which has been partially installed on all major construction projects.

### *Manualization of Procedures*

During the fiscal year, a basic system was developed to control the programing, budgeting, accounting, and reporting of Bureau activities. The primary emphasis has been on construction activities; and, although much work remains to be done on many of the detail elements of the system, and on its complete application to investigations, operation and maintenance, rehabilitation and betterment, and other substantive activities, the essential system is now in operation.

During the early months of the year, key personnel of the Office of Programs and Finance, in collaboration with representatives of the General Accounting Office, the Bureau of the Budget, and the Treasury Department, conducted a series of trial installations of a new system in several field offices in region 1. The offices were carefully selected to provide a representative cross-section of all types of Bureau activities.

The new program system covers control schedules, cost schedules, budget documents, and a system of program reports which reconcile with the financial records and accounts and provide complete integration of the budget documents with the program schedule and reports. A preliminary draft of procedures for construction activities has been issued and will be used as a prototype for extending the system to all other activities.

Major segments of the accounting system have been printed in final Manual form which includes the completely integrated system of

general ledger accounts, the procedure to control funds at all organizational levels, the allotment accounting system which will insure against the overobligation of funds and appropriations, integrated billing and collection procedure, and a complete system of financial statements and reports based on the new general ledger accounts.

With the co-operation of the Treasury Department, a modified disbursing procedure was developed, which eliminates the transmission of bulky documents to the Treasury Disbursing Offices, but retains all elements necessary for a thorough audit of disbursements by the General Accounting Office.

During the development of the new system, more than 50 forms and reports have been eliminated, and it is anticipated that at least 200 more will be eliminated by the time the new system is completed.

At the end of the year, work was in progress on the development of procurement and property accounting procedures, a simplified pay-roll and retirement accounting procedure, and the refinement and manualization of all of the program, budget, and reporting procedures.

### *Program Coordination*

Programing operations which provide for the proper coordination of all phases of the Bureau's activities into a sound construction program and the maintenance of the necessary administrative control to keep the program advancing along a prescribed path toward stated objectives was firmly entrenched during the year.

By the beginning of the fiscal year, a coordinated program and finance organization had been established throughout the Bureau and programing procedures, built up primarily around the control schedule, PF-2, and the annual project schedule, PF-3, had been promulgated and placed in service. While these procedures and documents have proved extremely valuable, the programing personnel has devoted considerable effort during the fiscal year to refining and improving those procedures in the light of actual experience in their preparation and use for the development and control of the project programs and for budget presentations. The instructions for the preparation of the various programing schedules have been revised to achieve greater uniformity in presentation, greater flexibility in programing so as to accommodate changing conditions and budgetary requirements, and more adequate presentation of the project content and scope. In addition, special attention has been given to coordinating the programing procedures and operations with the revised accounting system of the Bureau.

Coordination of programing and budgeting has been achieved by avoidance of hairsplitting definitions of functions and jurisdiction

TABLE 12.—Bureau of Reclamation schedule of advance construction program, fiscal years 1950-56—authorized projects

Project and State	Total estimated cost	Obligations June 30, 1949	Program of obligations							
			1950	1951	1952	1953	1954	1955	1956	Balance to complete
All-American, Ariz.-Calif.	\$76,993,213	\$52,094,635	\$6,325,251	\$4,662,000	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000	\$13,824,543
Austin, W. C., Okla.	13,206,000	12,146,315	328,205	263,000	134,257	139,000	139,000	112,725		-56,502
Belle Fourche, S. Dak.	4,638,884	4,638,180	20,704							
Boise-Anderson Ranch, Idaho	30,945,000	27,982,483	2,126,185	836,332						
Boise-Drainage, Idaho	160,000	32,435	5,000							122,565
Boise-Payette, Idaho	17,173,000	14,432,610	2,552,253	354,375						-166,238
Boulder Canyon, Ariz.-Nev.	173,900,000	151,355,617	6,621,782	7,000,000	5,000,000	2,600,000	1,100,000	221,021		
Buffalo Rapids, First Division, Mont.	2,735,000	1,899,453	73,254	190,316	295,000	235,000	181,977			
Buffalo Rapids, Second Division, Mont.	2,638,000	1,910,431	157,827	73,000	173,000	138,000	138,000	47,742		
Central Valley, Calif.	577,645,000	266,299,886	160,706,222	59,805,784	39,563,184	53,686,495	46,830,034	30,010,190	11,756,905	9,801,000
Colorado-Big Thompson, Colo.	150,503,000	76,493,134	20,973,593	22,000,000	17,351,250	8,600,000				5,085,113
Colorado River Front Work and Levee System, Ariz., Calif.-Nev.	18,980,000	3,344,241	951,460	2,025,000	6,175,000	5,075,000	2,600,000			-1,190,701
Columbia Basin, Wash.	773,339,000	298,914,434	72,020,341	55,500,000	34,200,000	38,700,000	32,000,000	27,100,000	23,200,000	191,704,225
Davis Dam, Ariz.-Nev.	114,438,000	60,650,984	37,362,539	15,722,640	536,000	90,000	83,911			-2,074
Deschutes-Arnold Irrigation district, Oreg.	207,150	151,269	38,941	17,000						
Deschutes-Grants Pass Irrigation district, Oreg.	102,200	2,200	83,800	16,200						
Deschutes-North unit, Oreg.	12,850,000	11,470,308	265,648	500,000	151,000	34,000	25,000	25,000		354,044
Deschutes-Ochoco Dam, Oreg.	1,076,000	118,466	947,534	10,000						
Eden, Wyo.	4,828,000	363,137	200,436	1,416,821	1,688,000	903,507	256,099			
Fort Peck, Mont.	16,250,000	4,603,151	2,931,838	1,743,000	1,577,000	1,125,000	522,000	809,000	1,080,000	1,859,011
Fort Sumner, N. Mex.	2,464,000	69,000	756,000	1,681,000	64,000					-100,000
Gila, Ariz.	53,560,235	14,492,630	5,993,623	7,308,000	7,947,000	5,088,000	2,727,000	2,727,000	2,292,000	4,984,982
Grand Valley, Colo.	5,243,840	4,992,959	1,581	111,035	138,265					
Hunley Horse, Mont.	108,800,000	19,216,769	22,521,472	31,000,000	20,400,000	12,200,000	3,461,759			
Kendrick, Wyo.	25,000,000	20,442,207	1,741,011	1,000,000	850,000	536,260	200,000	230,492		
Kern River, Calif.	125,000	6,000	8,700	18,000	57,000	35,300				
Kings River, Calif.	285,000	206,231	31,640	28,531	18,638					
Klamath, Oreg.-Calif.	17,782,298	11,894,822	1,309,086	1,000,000	1,092,390	1,560,000	800,000	126,000		148,760
Lewisston Orchards, Idaho	2,500,000	1,997,345	257,029	245,626						
Milk River-Fresno Dam, Mont.	2,000,000	1,746,200	64,210	40,800						
Minidoka, Idaho	28,153,000	23,919,568	457,704	419,515	3,359,213					
Missouri River Basin (various)	2,706,032,930	109,179,883	87,819,019	127,453,289	158,755,949	215,841,144	240,161,230	214,858,550	181,244,413	1,370,719,453
Ogden River, Utah	4,761,267	4,481,575	279,692							
Owyhee, Oreg.-Idaho	18,837,476	18,807,613	29,833	8,300,000	15,100,000	19,250,000	17,200,000	6,200,000	1,300,000	3,663,531
Palisades, Idaho	76,601,000	2,442,287	3,145,202	1,249,658	1,425,604	864,400				
Paonia, Colo.	4,747,000	646,845	559,495							

1 Includes \$784,700 contractors claims not included in total estimated cost.

TABLE 12.—*Bureau of Reclamation schedule of advance construction program, fiscal years 1950-56—authorized projects—Continued*

Project and State	Total estimated cost	Obligations June 30, 1949	Program of obligations							Balance to complete
			1950	1951	1952	1953	1954	1955	1956	
Parker Dam Power, Ariz.-Calif.	\$23,806,500	\$23,210,823	\$641,175							—\$5,498
Preston Bench, Idaho	453,000	428,688	21,312							
Provo River, Utah	28,050,000	18,607,871	4,370,304	\$2,151,000	\$1,552,275	\$1,308,550				
Rathdrum Prairie-Hayden Lake, Idaho	117,625	113,990	3,635							
Rehabilitation and betterment	37,780,900	1,263,240	2,736,760	5,000,000	4,919,500	2,815,000	\$2,175,400	\$1,500,000	\$4,434,400	15,439,600
Rio Grande, N. Mex.-Tex.	14,178,000	12,252,412	285,450	1,091,000	548,550					558
Riverton, Wyo.	21,813,403	13,512,106	2,526,116	3,658,000	2,067,000	523,000	45,734	—521,533		
San Luis Valley, Colo.	45,146,000	1,189,058	1,071,352	1,839,000	685,500	1,914,000	6,689,000	10,289,000	9,401,000	11,468,990
Santa Barbara County, Calif.	34,189,000	658,767	4,125,039	10,960,000	10,533,716	6,563,000	1,348,478			
Shoshone, Wyo.	16,851,705	13,259,945	780,162	358,000	1,507,000	150,000	239,000	295,000	229,208	42,390
Solano County, Calif.	45,577,000	0	100,000	1,250,000	4,550,000	12,315,000	13,610,000	8,780,000	4,972,000	
Sun River (Greenfields), Mont.	9,700,000	9,506,886	42,639	54,000						96,475
Tuenmeari, N. Mex.	16,730,000	15,166,841	605,704	218,000	218,000	106,601				414,854
Valley Gravity, Tex.	126,552,000	1,398,269	83,000	9,000	775,000	27,625,000	26,778,000	26,032,000	22,691,000	21,160,731
Water conservation and utilization (various)	11,988,665	11,589,583	387,904	11,178						
Weber Basin (initial imd.), Utah	69,534,000	331,961	334,100	1,000,000	5,899,939	8,550,000	7,177,000	6,900,000	7,125,000	32,216,000
Yakima-Kennecick, Wash.	10,736,000	674,000	50,000	1,940,000	3,115,000	3,114,000	4,873,000			
Yakima-Roza, Wash.	22,868,000	20,171,646	466,873	1,030,000	1,013,000					186,481
Total	5,585,642,291	1,366,718,337	1,358,896,595	382,530,100	353,451,230	431,758,257	408,281,622	335,802,167	266,745,710	1,082,232,973

† Includes \$784,700 contractors claims not included in total estimated cost.



Project and State	Rate of power development—kw. (in thousands)							Rate of irrigation development—acres (in thousands)										
	Existing June 30, 1949	1950	1951	1952	1953	1954	1955	1956	Esti- mated addi- tional	Existing June 30, 1949	1950	1951	1952	1953	1954	1955	1956	Esti- mated addi- tional
All-American, Ariz.-Calif.										3.0	32.0	24.3						
Austin, W. C., Okla.										430.0	12.0	9.0						
Belle Fourche, S. Dak.										50.0								
Boise-Anderson Ranch, Idaho.		13.5	13.5															
Boise-Drainage, Idaho.										100.0	200.0							
Boise-Payette, Idaho.										46.7	6.0							
Boulder Canyon, Ariz.-Nev.	1,034.8		165.0	50.0	82.5					14.2	.6	.9						
Buffalo Rapids, First Division, Mont.																		
Buffalo Rapids, Second Division, Mont.										5.7	3.5	2.4						
Central Valley, Calif.	375.0	75.0				160.0	120.0	80.0	45.0	38.5	14.0	216.5	90.0	40.0	30.0	30.0	29.0	153.0
Colorado-Big Thompson, Colo.	21.6	53.1			102.7					19.0	5.0	54.0	408.0	147.0	85.0			
Colorado River Front Work and Levee System, Ariz.-Calif.-Nev.																		
Columbia Basin, Wash.	1,100.0	334.0	324.0	216.0						5.6	1.2		87.0	68.6	69.7	86.2	74.7	640.0
Davis Dam, Ariz.-Nev.			225.0															
Deschutes-Arnold irrigation district, Oreg.																		
Deschutes-Grants Pass irrigation dis- trict, Oreg.										50.0								
Deschutes-North unit, Oreg.	1.5									46.0								
Deschutes-Ochoco Dam, Oreg.																		
Eden, Wyo.										9.0				11.0				

F = Full supply.  
S = Supplemental supply.



Provo River, Utah.....																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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F = Full supply.

S=Supplemental supply.

and by maximizing the interchange of information between the two processes. While the programing precedes budgeting in point of time and the processes have independent courses, requirements and time-scheduling, a close working relationship was maintained between the two functions to achieve a well coordinated operation for the development of sound realistic programs and the translation, in a limited amount of time, of those programs into budgetary forms.

The financing and programing problems arising from the continuation of construction on the remaining nearly completed Water Conservation and Utilization projects was examined. Completion of some of these projects requires substantial additional expenditures and the remaining construction cannot be undertaken without additional authority, either because of provisions contained in the basic authorization relating to the total cost or because of the disproportionate repayment arrangements brought about by increased costs.

### *Appropriations*

The regular and supplemental appropriations for 1949 of \$266,763,-964 were the largest ever received by the Bureau. With an unused balance of \$32,318,077 from the previous year, the money available for Reclamation totaled \$298,982,041—the largest annual program in the history of the Bureau.

Due in large part to unexpected delays in the passage of supplemental appropriations amounting to over 20 million dollars (such appropriations being made available in the latter part of the fourth quarter), at the end of the fiscal year there was an unobligated 35½ million dollars carried over into fiscal year 1950. On the same basis, obligations for fiscal year 1949 totaled 264.5 million dollars, representing 88.5 percent of work programed in 1949 compared with 88 percent accomplished in fiscal year 1948 and 82 percent for fiscal year 1947.

Certain restrictions in the 1949 Appropriation Act, as in 1948, handicapped the Bureau during the year in its construction program. One restriction was the limitation placed on construction work by Government forces ("force account" work), whereby not to exceed 8 percent of the appropriation of any project could be so used. Although most Reclamation work is done by contract with private construction firms who build according to Bureau design and under the supervision of Bureau engineers, some activities are outside the general contracting field, risks are great, and contractors either are not interested or feel that they must protect themselves by higher bids.

Another restriction was a limitation during the greater part of the fiscal year of \$7,800,000 on design work for the projects performed by



the Bureau's central design office at Denver. While this limitation was increased to \$9,250,000 in the last quarter of the year, it still had the effect of limiting service at a time when construction work was being accelerated. It was necessary to continue a large part of the design work in the project offices where difficulty to recruit and retain experienced personnel was encountered.

A \$50,000 restriction upon expenditures for General Offices public informational services again materially impaired the ability of the Bureau to respond to increased requests for information from the Congress, the press, and the public, resulting from added interest caused by the expanded construction program. The burden of this work fell to a great extent on an overtaxed technical staff and on officers responsible for the prosecution of the construction program, hampering performance of regular work for which they were responsible.

Restrictions limiting the amount which could be expended for personal services of all kinds to \$48,000,000 and the number of employees in grades CAF-9 and P-3 and above to 3,500 were important factors in the Bureau's inability fully to execute the program scheduled. The limitation for all personal services was increased to \$54,500,000 in the last quarter of the year, but here again the relief came too late to have any real salutary effect on the Bureau's program, and as a result the unobligated balance carried over into 1950 was considerably increased.

Finally, a restrictive clause setting forth the qualifications required for persons holding the offices of Commissioner, Assistant Commissioner, and Regional Director resulted in the Commissioner and the Director of Region 2 serving without pay from January 31 to June 30. Request for a supplemental appropriation to cover the salaries of these officials thus withheld has been submitted.

Reclamation construction work in the West was originally financed from the Reclamation fund, which consisted of money received from the sale of public land supplemented by small loans from the Treasury and, later, oil royalties. In 1916, Congress began to make annual appropriations out of the fund for the work and the Bureau was required to budget its needs for the coming fiscal year's operations and justify the appropriation requested in the same manner as all other Government agencies.

Funds made available to the Bureau from its inception to date are shown in the following table. From 1902 to 1915 the amounts shown were authorized by Secretarial action. Subsequent amounts were appropriated by Congress.

TABLE 13.—*Allotments from Reclamation fund, 1902-15, appropriations from Reclamation and general funds, 1916-49, and emergency fund allocations (NIRA, PWA, and ERA)*

Fiscal year	Allotments from Reclamation fund	Appropriations (including revenue authorizations)	Emergency fund allocations	Total
1902.....	} <sup>1</sup> \$855,000			<sup>1</sup> \$855,000
1903.....				
1904.....	<sup>1</sup> 18,200,000			<sup>1</sup> 18,200,000
1905.....	<sup>1</sup> 8,758,000			<sup>1</sup> 8,758,000
1906.....	<sup>1</sup> 2-9,711,173			<sup>1</sup> 2-9,711,173
1907.....	<sup>1</sup> 15,211,407	<sup>1</sup> 1,000,000		<sup>1</sup> 16,211,407
1908.....	<sup>1</sup> 10,011,765			<sup>1</sup> 10,011,765
1909.....	<sup>1</sup> 10,378,950			<sup>1</sup> 10,378,950
1910.....	<sup>1</sup> 8,504,050			<sup>1</sup> 8,504,050
1911.....	24,722,790			24,722,790
1912.....	7,286,000			7,286,000
1913.....	6,229,000			6,229,000
1914.....	9,764,166			9,764,166
1915.....	11,742,042			11,742,042
1916.....		13,530,000		13,530,000
1917.....		8,902,557		8,902,557
1918.....		8,537,213		8,537,213
1919.....		9,840,277		9,840,277
1920.....		7,848,927		7,848,927
1921.....		9,124,177		9,124,177
1922.....		20,601,871		20,601,871
1923.....		15,359,530		15,359,530
1924.....		12,564,067		12,564,067
1925.....		13,640,809		13,640,809
1926.....		12,363,240		12,363,240
1927.....		7,556,320		7,556,320
1928.....		12,203,800		12,203,800
1929.....		14,443,400		14,443,400
1930.....		8,743,000		8,743,000
1931.....		20,242,000		20,242,000
1932.....		22,371,000		22,371,000
1933.....		25,866,953		25,866,953
1934.....		11,456,335	<sup>1</sup> \$87,205,098	98,661,433
1935.....		1,176,750		31,700,537
1936.....		15,438,100	36,883,746	57,321,846
1937.....		56,444,600	1,646,362	58,090,962
1938.....		42,417,600	31,089,515	73,507,115
1939.....		45,410,600	2,376,654	47,787,254
1940.....		78,165,600	2,715,032	80,880,632
1941.....		74,533,600	13,514	74,547,114
1942.....		102,776,031	24,824	102,800,855
1943.....		91,663,670		91,663,670
1944.....		41,610,575		41,610,575
1945.....		27,434,000		27,434,000
1946.....		120,943,650		120,943,650
1947.....		119,631,088		119,631,088
1948.....		143,185,038		143,185,038
1949.....		266,203,767		266,203,767

<sup>1</sup> Calendar year.<sup>2</sup> Negative amount reflects partial invalidation of previous allotments.

The amount appropriated, including all supplementals for fiscal year 1949 for each activity, is as follows:

TABLE 14.—*Condensed statement of appropriations, fiscal year 1949, exclusive of trust funds*

Appropriation	Amount
Reclamation fund, special fund:	
Salaries and expenses.....	\$3,860,000
General investigations.....	3,500,000
Construction <sup>1</sup> .....	18,250,810
Operation and maintenance—direct appropriation (irrigation).....	\$1,841,853
Operation and maintenance—power revenues.....	6,999,601
Operation and maintenance, total.....	8,841,454

<sup>1</sup> In addition, Appropriation Act permits contract authorization of \$1,600,000 for Santa Barbara County project, California (Cachuma Unit) and \$2,000,000 for Palisades project.

TABLE 14—*Condensed statement of appropriations, fiscal year 1949, exclusive of trust funds—Continued*

Appropriation	Amount
Reclamation fund, special fund:—Continued	
Emergency fund.....	\$1,000,000
Rehabilitation and betterment of existing projects.....	1,500,000
Total, Reclamation fund, special fund (includes appropriation from power revenues).....	36,952,264
General fund:	
Alaskan investigations.....	150,000
Construction.....	227,211,700
Total, general fund.....	227,361,700
Colorado River Dam fund:	
Colorado River development fund (expenditure account).....	900,000
Boulder Canyon, operation and maintenance.....	1,550,000
Colorado River Dam fund, total.....	2,450,000
Total, general and special funds (includes appropriation from power revenues).....	266,763,964

Funds available for appropriation from the Reclamation fund, and actual and estimated appropriations therefrom for fiscal years 1949–51, are shown in the following tabulation:

TABLE 15.—*The Reclamation fund, 1948–50, funds available for appropriation*

Item	Actual 1948	Actual 1949	Estimate 1950
Unappropriated balance brought forward (as of June 30).....	\$14,173,102	\$24,759,576	\$41,136,791
Accretions to fund:			
Public land sales.....	412,654	1,014,906	450,000
Mineral Leasing Act.....	10,070,710	18,347,297	14,000,000
Potassium royalties and rentals.....	133,352	17,876	150,000
Federal power licenses.....	33,134	—	35,000
Rights-of-way, withdrawn lands.....	1,417	197	1,000
Income from accretions.....	10,651,267	19,380,276	14,636,000
Repayment income:			
Construction charges collected.....	3,258,592	3,481,372	3,500,000
Operation and maintenance collections.....	513,661	566,961	575,000
Power revenues.....	29,492,540	15,921,773	17,000,000
Water rentals.....	425,922	1,410,327	1,500,000
All other (rental from grazing and farming lands, reimbursements, etc.).....	1,921,242	2,568,770	2,600,000
Total repayment income.....	35,611,957	23,949,203	25,175,000
Total available for appropriation.....	60,436,326	78,089,055	80,947,791
Deduct appropriation or estimate for:			
Salaries and expenses.....	3,130,000	3,860,000	4,200,000
General investigations.....	2,000,000	3,500,000	3,700,000
Investigations, Upper Colorado River Basin.....	—	—	500,000
Advance planning.....	—	—	50,000
Construction.....	13,558,250	18,250,810	20,977,463
Operation and maintenance.....	6,988,500	8,841,454	11,702,872
Rehabilitation and betterment of existing projects.....	—	1,500,000	—
Emergency fund.....	—	1,000,000	—
Total appropriation or estimate.....	25,676,750	36,952,264	41,230,335
Balance carried forward.....	34,759,576	41,136,791	39,717,456

## *Reports*

The submission to the Senate and House Appropriations Committees of quarterly reports on the status of funds appropriated for construction was continued during fiscal year 1949, following the pattern developed in the previous year. Similarly, recurring reports continued to be prepared at the project level to reflect current, cumulative, and anticipated contractors' earnings. A modified system of reports, geared to the newly streamlined accounting system of the Bureau, took form as the year progressed. The new reports, aiming particularly at a more immediate comparison of program and progress, serve as a specific instrument in management control. By June 30, most projects had submitted test runs in compliance with revised procedures then approved. Fiscal year 1950 submissions are to be prepared under the modified reports system as progressively developed.

Special monthly tabulations provided a means for close surveillance during the year of prospective year-end carry-over of unobligated funds and of unliquidated obligations. Program attainments could thereby be more accurately gaged and encouraged, and planning emphasis more precisely directed.

In accordance with provisions in the Interior Department Appropriation Act of 1949, the amounts of accrued contractors' earnings retained as hold-backs became unavailable for obligation for any purpose, no matter when payments of such withheld percentages were to be made. To give effect to the legislation, hold-backs were deposited in special accounts.

To meet administrative and operating needs for frequently used, single-source statistical data, a set of four ready-reference books was compiled, consisting of (1) a volume entitled "Bureau of Reclamation Appropriation Acts and Allotments," containing exact copies of all appropriation acts relating to the Bureau from its establishment in 1902 to 1949; (2) a volume entitled "Bureau of Reclamation Project Feasibilities and Authorizations," presenting project findings of feasibility and authorizations for projects during this period; (3) a volume entitled "Bureau of Reclamation Public Notices," consisting of a collection of notices issued; and (4) a volume entitled "Bureau of Reclamation Project Finance Data" in tabular form, exhibiting basic statistical finance data on each project progressed by the Bureau during its existence through fiscal year 1949.

The restrictions imposed by the 1949 Appropriation Act which limited expenditures for personal services to \$48,000,000 and the number of personnel in grades P-3, CAF-9, and above to 3,500, was administered by means of allocations, controls, and reports. The dollar limitation necessitated the reduction in personnel from a total of 16,862 full-time employees in July 1948 to a total of 13,002 by January 1949—



a reduction of 3,860 representing 23 percent. This low level of employment continued under the limitation into May 1949. With relief given by the First Deficiency Appropriation Act of 1949 which, among other items, revised the personal-services dollar limitation to exclude Public Law 900 and trust and contributed funds, recovery in total full-time employment in June reached 15,401 at the year end. Throughout the year employment in grades P-3, CAF-9, and above was maintained within the limitation of 3,500 positions in this category.

The consolidated statement by projects of construction cost of irrigation and power works, other items reimbursable with construction, and deductions for fiscal year 1949, similar in presentation to that appearing on pages 88-91 of the 1948 Annual Report of the Secretary, has been omitted pending completion of revision of the Bureau's accounting system.

## COMPTROLLER

The Office of the Comptroller continued on an expanded basis the consultative and advisory assistance to the Commissioner and his top staff; the review and approval of proposed accounting procedures and other system elements; and the performance of independent financial audits of Bureau projects, water users' associations, contract settlements, and other features of Bureau operations.

In the field of policy development and advisory assistance, this Office has played a conspicuous role in problems of municipal finance and management, special studies of the interagency agreements, analysis and interpretation of external audit reports, and problems relating to the effect of legislative developments.

The over-all program of water users' audits reflected substantial progress. All urgent requests for audit and advisory assistance adjunctive thereto were filled. This work involved removal of a backlog of several years. Auditing policies and procedures for this activity were improved for more significant results both from a practical and technical standpoint.

In terms of satisfaction of Bureau requirements and Comptroller's office objective, the fiscal year 1949 marked the first really concrete accomplishments in the important program of project financial auditing. Auditors were equipped with specific performance standards and job instructions. Audits of major projects were undertaken for the first time. While intensity of audit activity varied as between regions, at least one project in each region was covered.

The financial audits were adjusted by the installations of the Bureau's new accounting system which were concentrated largely in the 1949 fiscal year. It was considered desirable to audit following

account conversions, and since the audit program had been initially constructed around the old account structure, a substantial burden of training and reprogramming was required.

On the basis of more representative evaluation factors provided by this year's performance by the Office of the Comptroller, technical instructions are being amplified, more rigid time performance requirements are being instituted, and organizational changes aimed at maximum accomplishment are being directed.

## LEGISLATION

Several bills of far-reaching significance to present and future water and power users on Reclamation projects were introduced in the Congress during the fiscal year. One of the bills of most importance to the Bureau's program to be enacted by the first session of the Eighty-first Congress is Public Law 37 (S. 790), granting the consent of the United States to the Upper Colorado River Basin Compact. The compact makes an equitable division among the States of Arizona, Colorado, New Mexico, Utah, and Wyoming, of the waters of the Colorado River System, the use of which was apportioned to the Upper Basin by the Colorado River Compact of 1922. There was also enacted Public Law 82 (H. R. 4151), granting the consent of the United States to the Arkansas River Compact, which relates to the use of the waters of the Arkansas River by the States of Colorado and Kansas, and Public Law 91 (H. R. 3334), granting the consent of the Congress to the Pecos River Compact, which provides a division of the waters of the Pecos River between New Mexico and Texas. All three measures were reported on favorably by the Department.

Another bill of vital interest to the Bureau to be enacted is Public Law 56 (H. R. 4152), the first omnibus amendatory repayment contract measure to be passed by the Congress. This measure authorizes the execution by the Secretary of the Interior of amendatory repayment contracts negotiated, pursuant to section 7 of the Reclamation Project Act of 1939, with the Bitter Root irrigation district, the Shasta View irrigation district, the Okanogan irrigation district, the Willwood irrigation district, the Uncompahgre Valley Water Users' Association, and the Kittitas reclamation district. There is now pending House bill 5184, which would authorize the Secretary to execute amendatory repayment contracts negotiated under section 7 of the Reclamation Project Act of 1939 with the Belle Fourche irrigation district, the Deaver irrigation district, the Westland irrigation district, the Stanfield irrigation district, the Vale Oregon irrigation district, and the Prosser irrigation district. Favorable action by the Congress on this bill is anticipated.

Public Law 132 (S. 55) provides the necessary authorization to permit the Bureau of Reclamation to complete the construction of the irrigation facilities of the Eden project, Wyoming, as originally authorized by the President on September 18, 1940, as a Great Plains project, with such modifications as the Secretary may find will result in greater engineering and economic feasibility.

The enactment of Public Law 102 (S. 690) authorizes the delivery of water to the Yuma auxiliary project through the irrigation system of the Yuma Mesa division of the Gila project, a reduction in project lands by excluding lands which cannot successfully be irrigated under present conditions, and the effecting of related physical and financial adjustments.

In addition to the public laws set forth above, a number of private bills arising out of Bureau activities were enacted for various purposes.

Several measures introduced in Congress were still pending as of the close of the fiscal year. They are discussed briefly because of their importance, inasmuch as their enactment would make basic changes in the reclamation laws and the Bureau's program. They have received extensive consideration in the Office of the Chief Counsel and other branches of the Bureau.

A measure having greatest interest to the Bureau is House bill 1770, which would provide for certain revisions in section 9 of the Reclamation Project Act of 1939. One objective of this bill is to give statutory recognition to the fact that multipurpose Federal Reclamation projects frequently serve various purposes in addition to those now covered by law (principally, irrigation and the production of hydroelectric power), and to provide that the whole cost of facilities which serve these additional purposes need not be borne by the water users and consumers of electric power. This objective would be achieved by writing into the Reclamation Project Act of 1939 authority to make nonreimbursable allocations of capital and operation and maintenance costs to flood control, navigation, fish and wildlife propagation, recreation, general salinity control, sediment control, the improvement of public transportation, protection of the public health, promotion of the national defense, and the fulfillment of international obligations. Only the first three of these items are now provided for by statute and, as to them, present law covers only allocations of capital costs.

The second objective of the bill is to afford the basis for an improved contract relationship between the Bureau of Reclamation and its irrigation water users. Amendments of section 9 (d) of the Reclamation Project Act of 1939 would (a) permit annual repayment installments to vary according to the terms of such formula as the water users and the United States agree upon, (b) make it clear that section 8 of the 1902 Reclamation Act applies to section 9 (d) repayment con-

tracts, and (c) provide for the transfer of works for care, operation, and maintenance by organizations of water users. Section 9 (e) would be amended to provide (a) that the repayment contract rates could be fixed for the entire term of the contract or they could be made to reflect changes in the financial condition of the contracting organization, (b) that section 9 (e) contracts would be made specifically subject to section 8 of the 1902 Reclamation Act, (c) that such contracts would be renewable, at the option of the contracting organization, on terms and conditions agreed to by the parties, (d) that payments made under a section 9 (e) contract, over and above operation and maintenance costs, will be credited to the construction cost obligation of the contracting organization when it enters a section 9 (d) contract. In addition, the bill would permit existing repayment contracts to be replaced with new contracts which would conform, as nearly as practicable, to the provisions of section 9 (d) and (e), as amended.

The consolidation of the Parker Dam Power project and the Davis Dam project was proposed in House bill 2984. This bill would permit economies and increased efficiency in the construction, operation, maintenance, and administration of these projects.

House bill 1694 would authorize the repayment of rehabilitation and betterment costs to be deferred in those cases where current financing of such work is beyond the repayment ability of the water users.

House bill 4403 would authorize the Secretary of the Interior to develop, administer, and dispose of the recreational facilities within reclamation, flood-control, power, and other Federal reservoir projects under his jurisdiction. Similar legislation applicable only to facilities on the Colorado-Big Thompson project is proposed in House bill 5134.

The development of certain works in the American River Basin, California, as a part of the Central Valley project would be authorized by House bill 165. In addition, this bill would provide that, after construction is completed, Folsom Dam and Reservoir would be transferred by the Corps of Engineers to the Bureau of Reclamation for operation and maintenance.

Also of importance is House bill 940, the Alaska development bill, which, among other things, would authorize the construction of the Eklutna power project near Anchorage.

Several project authorization bills were pending, but had not been acted upon finally at the close of the fiscal year. These include Senate bill 75, to authorize the Central Arizona project, and provide for the construction of the Bridge Canyon Dam and Reservoir as one of its features; Senate bill 276, to authorize the Fort Sumner project, New Mexico; Senate bill 1382, to authorize the Vermejo project, New Mexico; House bill 2733, to authorize the Canadian River project, Texas; Senate bill 167, to authorize the Weber Basin project, Utah;



and House bill 163, to authorize the construction of canals for the irrigation of presently dry areas on the east and west sides of the Sacramento River as part of the Central Valley project.

There would be restored to the Secretary of the Interior, if Senate bill 1606 is enacted, the determination of the validity of titles to lands acquired in the administration of the reclamation laws. In 1946, the Attorney General held that the final determination of title validity under existing law must be made by the Department of Justice.

A favorable report was made by the Interior Department on House bill 2514, which would enable the Secretary of Agriculture, through the Farmers Home Administration, to extend financial assistance to entrymen on Federal reclamation projects.

Among the bills pending in Congress in which the Bureau of Reclamation is interested and on which unfavorable reports have been made are House bill 915, intended to authorize the Department of Agriculture to investigate and report on projects for the reclamation of lands by drainage; that portion of House bill 5472, the Omnibus Flood Control and Rivers and Harbors bill, which relates to the construction of the Grand Prairie reclamation project, Arkansas, by the Corps of Engineers, and Senate bill 33, which would create a National Water Conservation Authority to study the conservation, development, and utilization of the Nation's water resources.

### *Litigation*

The Bureau was concerned with extensive litigation involving important legal principles affecting its operations. Four additional actions were filed against the United States in the Court of Claims during this fiscal year to receive compensation for damages alleged to have been sustained by the plaintiffs as a result of the construction and operation of Friant Dam, Central Valley project, California. This brings the number of such cases to 52, in which over \$2,000,000 in damages is sought.

The United States Supreme Court granted certiorari to review the judgments entered by the Court of Claims and heard arguments in the case entitled *Gerlach Live Stock Company v. United States*, and five related cases (102 C. Cls. 392; 76 F. Supp. 87, 99). The Supreme Court subsequently decided to have these cases reargued at its next term. In addition, suits are pending in the United States District Courts for the Southern District of California and for the District of Columbia which seek to enjoin the United States from diverting and transporting waters of the San Joaquin River to lands outside the watershed of that river or from entering into contracts for the sale of water of the San Joaquin River.

An action was filed by the United States in the United States District Court for the District of Colorado against the Northern Colorado water conservancy district, the city and county of Denver, and others. The principal purposes of the suit are to quiet the United States title in the waters of the Blue River required to operate Green Mountain Reservoir of the Colorado-Big Thompson project and to obtain a judicial construction of the meaning and effect of certain portions of Senate Document 80, Seventy-fifth Congress. An answer filed by the Public Service Co. of Colorado challenges the statutory authority of the Secretary of the Interior and the constitutional authority of the United States to construct transmission lines.

There are still pending the cases entitled *Fine Sheep Co. v. United States*, *Ira R. Ure et al. v. United States*, *Ira R. Ure v. United States*, and *Scheff White et al. v. United States*, and consolidated cases, instituted in the United States District Court for the District of Oregon pursuant to the Federal Tort Claims Act. These cases include 191 actions for alleged damage to crops by reason of a failure to deliver water and two actions for alleged damage caused by flooding resulting from a break which occurred in the North Canal of the Owyhee project. Assistance was given the Department of Justice in the conduct of the trial of these cases and the preparation of legal briefs and arguments.

An action entitled *Washington Water Power Co. v. United States* was instituted in the United States Court of Claims to recover for damages allegedly caused to the plaintiff's Little Falls power plant on the Spokane River in the State of Washington by reason of the filling of the Franklin D. Roosevelt Reservoir, Columbia Basin project.

In the case of *United States v. Alpine Land and Reservoir Company*, which has been pending for more than 20 years in the United States District Court for the District of Nevada, a preliminary determination and adjudication and a temporary restraining order was entered providing for the distribution of the waters of the Carson River in Nevada.

Assistance was given representatives of the Department of Justice in two cases pending before the United States District Court for the District of Utah. These actions are entitled *Provo Bench Canal and Irrigation Company et al. v. United States*, which involves an appeal from a ruling of the State engineer affecting the water rights acquired by the United States for the Provo River project, Utah, and *United States v. Lloyd*, which was instituted by the Government to enjoin the operation of a fish-processing plant that was polluting the water stored in the Deer Creek Reservoir of the Provo River project.

The United States Circuit Court of Appeals for the Tenth Circuit affirmed a District Court decision against the United States in the declaratory judgment action entitled *United States v. Pruden et al.*

(172 F. 2d 503). This case was instituted to determine the rights of the United States under an Oklahoma statute granting a free right-of-way for canal purposes to the United States across State land in those instances where such lands were conveyed by the State without an express reservation in the deed of the right-of-way.

Possible means of bringing to a conclusion the case of *Pioneer Irrigation District v. American Ditch Association et al., United States of America, Intervener*, were explored with representatives of the Department of Justice. This action, which has been pending for many years in the Seventh Judicial District Court of the State of Idaho, was instituted to determine the rights of the several parties to the waters of the Boise River.

A hearing was held before a commissioner appointed by the United States Court of Claims in the action entitled *Columbia Basin Orchard et al. v. United States*, which arose by reason of the alleged contamination by the United States of the source of water of the Columbia Basin orchard.

Two suits involving one prime contractor and one subcontractor, entitled *David A. Richardson v. United States* and *Ralph G. Barnes v. United States*, were filed in the Court of Claims pursuant to the War Hardship Claims Act on account of losses allegedly sustained under six contracts because of war conditions. Legislation is pending which would authorize District Courts to ascertain the amount of losses, if any, sustained by four contractors because of the Government's failure to furnish steel during the steel shortage of 1945 and 1946.

The Court of Claims ruled against the Government in the case *Cotton Land Company et al. v. United States* (109 C. Cls. 816). This action was instituted to recover damages for the flooding and isolation of plaintiffs' lands allegedly resulting from the formation of a delta in the Colorado River which was caused by the construction and operation of Parker Dam. The determination of the amount of damages is now pending.

A settlement was made and final judgment entered in the Court of Claims case entitled *California Zinc Company, et al. v. United States* (112 C. Cls. 577), involving a claim which resulted from the impounding of water in the Shasta Reservoir, Central Valley project.

Over 100 proceedings to acquire lands and rights-of-way by condemnation were instituted during the fiscal year. Many of these cases involve the acquisition of two or more parcels of land. The acceptability of proposed settlements, awards of commissioners appointed by the courts and of juries in many of these cases, and cases instituted previously were considered.

*General.*—Legal research, assistance, and draftsmanship in connection with all phases of the Reclamation program has been carried on in the Office of the Chief Counsel. Some of these matters include: Consideration of the effect of the 1944 Mexican Water Treaty on certain Bureau project operations; preparation of a draft of consolidated form of all major delegations of authority granted to the Bureau of Reclamation by the Secretary; preparation of general regulations relating to the opening of public lands on Federal reclamation projects; assistance to the Gila Valley power district and Mohawk municipal water conservation district in the liquidation of their indebtedness through composition proceedings which will permit the dissolution of these districts and the formation of a new district authorized to contract with the Government, in accordance with the provisions of the Act of July 30, 1947 (Public Law 272, 80th Cong., 1st sess.); consideration of many questions arising out of limitations which were included in the appropriation act for this fiscal year; and negotiation and drafting of repayment contracts, amendatory repayment contracts, construction contracts, and power contracts, together with a consideration of the legal problems arising out of proposed provisions. Many claims against the United States were considered under a delegation to all Bureau Regional Counsel to administratively determine claims up to \$1,000 filed under the Federal Tort Claims Act and the claim items appearing in the annual appropriation acts. The general work range included practically the entire field of Reclamation activity.

## MANAGEMENT PLANNING

### *Organization and Management*

No changes were made in the Bureau's basic organization structure during the year. Adjustments were made in the Denver and field design organizations and in the scope of certain district offices. Plans were made toward full participation by the Bureau in the President's management improvement program (officially promulgated on July 29, 1949).

### *Manual of Instructions*

The Reclamation Manual, which will encompass all policy and procedural instructions, methods, and standards for carrying out the Bureau program, was substantially completed in initial form. Substantial progress was also made in a revision of the preliminary material based on its application to operating conditions in the field.



*Reports and Forms Review and Coordination*

Near the close of the fiscal year, a review of all forms used in the Bureau was initiated. This forms program, together with the analysis and coordination of reports, will provide a system through which the regional personnel and the Commissioner's staff offices may jointly review and improve Bureau reports and forms, and the procedures governing their use.

*Administrative Review*

The administrative review program was continued on a relatively limited scale, but with good results. Selected functions of the Bureau were reviewed jointly by the branch or office having primary responsibility for the function and by management personnel, and plans and recommendations developed for the improvement of operations and the resolution of organizational problems.

**PERSONNEL**

Although still restricted by congressional limitations on the number of employees who could be engaged on personnel work, the Bureau personnel staffs have striven to achieve the objectives described in the Annual Report for 1948. The large postwar void between the thin crust of old and able career leaders on the top and the mass of new recruits on the bottom has been progressively narrowed. Development and utilization programs upon which will depend the Bureau's success of 10 or 20 years from now have been initiated. The total objectives of these plans is the development of practical means whereby management can attract and keep positions filled with competent people and have available a reserve of qualified employees selected and trained in advance for promotion or reassignment to new positions in accordance with anticipated scheduled replacements based on forecasts of future staffing needs.

This year brought more and more recognition and reliability to the fact that personnel administration is a direct responsibility of operating management. At every possible level in the program, the available personnel staff devoted itself to assisting management in the establishment, development, and maintenance of a work force which would most effectively meet the Bureau's operational requirements. The second year of Bureau-wide operation of the student engineer program marked its continuance as a well-organized and stable development plan. Pilot programs for junior administrative trainees, apprenticeship training in the six basic crafts, and rotation of engineers in the beginning professional grades have been started. Based upon experi-

ence gained with these pilot operations, they will be extended to other regions, districts and projects where needed. Other programs now under way on a pilot basis include the planning and programming of personnel requirements, the use of the construction engineer position as a guide for selecting and developing employees for more responsible assignments, and manpower scheduling for field-design offices.

Position classification to determine appropriate service and grades for positions under the Classification Act was geared to and focused upon creating understanding and effectively utilizing position classification for the benefit of better management. Through inspection surveys and review of decentralized field operations it is planned to evaluate existing allocations and to develop policies and procedures to improve and standardize the conduct of this important responsibility of personnel management.

A collective-bargaining type of labor agreement affecting several hundred wage board employees has been initiated on one major Reclamation project. Equitable hourly rates, based upon the principle of paying employees in accordance with local prevailing rates were kept current by the Bureau's wage boards.

Through its labor relations officers, salary and working conditions for approximately 18,000 contractors' employees were considered. These officers are in close touch with local and national civic organizations, labor unions, contractors, and many others who concern themselves with this working force.

Continued operation of the Bureau's safety program resulted in a 25-percent reduction this year in the lost-time frequency rate under the rate established during 1948. Safety inspections were performed on all Bureau operations and a safety educational program was conducted.

The Bureau continued to enjoy its hard-won prestige as a good place in which to work. More than 12,500 people applied for examinations announced by the Bureau's Central Board of Civil Service Examiners. As a result of these examinations, approximately 1,500 candidates obtained competitive civil service status appointments. On June 30, 1949, the Bureau had on the rolls 15,653 employees; 12,074 of whom were under the Classification Act; 3,505 under the wage boards, and 74 on other types of appointments. Of this number 7,896 were veterans.

Such incentives as rewards for superior accomplishment, and suggestions, paid off to 73 employees in the amount of \$8,924, with Earle D. (Dusty) Rhoades, drilling superintendent of the Columbia River district, being awarded \$1,000 for his "multiple packer" drilling device, which held promise of saving large sums of money in the construction of dams.

## SUPPLY

*Airplane Operations*

Three Fairchild, single-engine, four-place aircraft were procured from surplus and completely overhauled and modernized for use throughout the Bureau. One of these airplanes was assigned to region VI, one to region VII, and one is awaiting assignment, and temporarily assigned to the Washington Office. The Bureau's Lockheed Lodestar was flown approximately 300 hours during the year, and provided transportation for members of the Secretary's staff, as well as for Bureau officials. This aircraft, as well as the two twin-engine Beechcraft, one of which is assigned to region VI and the other to region III, have been used for inspection work at Bureau projects, which could not have been accomplished except through this means of transportation. In addition to providing a means of visual inspection of dam sites and all projects under construction, the aircraft have been used for making preliminary surveys of transmission lines, the surveillance of flood-water conditions, and for photograph work, including some aerial survey work.

Two of the Bureau's fleet of airplanes were lost in a fire at Amarillo. Provisions have been included in the 1950 Appropriation Act to procure replacements for these aircraft.

*Procurement Activities*

Work with reference to the decentralization of the Bureau's procurement work has gone steadily forward during the year. Field procurement offices have been delegated authority to consummate contracts where the amounts do not exceed \$200,000.

An agreement was consummated through the Secretary of Commerce to have allocated to the Bureau all steel needed to keep our construction program on schedule. This steel allocation program was abandoned during the last quarter when the steel market broke and steel became generally available. Had it not been for our participation in the steel allocation program, a number of our construction projects would have been delayed.

The very tight supply situation, with reference to aluminum conductor cable, large size insulators and certain types of pole line hardware, was overcome due to a tabulation of the entire Bureau needs for these commodities and a presentation of these requirements to the various sources of such materials. As a result of this scheduling of our needs, we are now in a position to procure these items on relatively short delivery schedules.

We have continued our efforts to procure favorable rates for transporting materials being shipped to Bureau projects, and as a result of placing freight rate specialists in the several regional offices we have reduced the cost of transporting materials being purchased by the Bureau for use in projects presently under construction. A plan for controlling Bureau purchases and of coordinating such purchases with the design and construction program has been developed and is presently being placed in operation on a trial basis at one of our large projects.

During the year we have audited and inspected procurement activities at regional and project levels. Such audits have revealed that generally the procurement work of the Bureau is on a sound basis and that personnel assigned to this work are qualified to perform such functions in accordance with the laws, rules and regulations governing this work. These inspections have confirmed the fact that the Bureau's policy to decentralize such activities was sound and that it, generally, has resulted in reducing the time element necessary to procure materials, supplies and equipment, and as well has effected economies and assured such items being delivered when needed.

Studies have been undertaken during the year with a view to reducing the paper work involved in open market buying, and representatives of this office have cooperated closely with the Bureau of Federal Supply and other governmental agencies in the development of a new type of procurement document that will serve as a requisition, purchase order and voucher and which, we are convinced, will result in a savings in the paper work involved in this sort of procurement work.

### *Property Management Activities*

During the year a vigorous campaign has been conducted to assure the handling of Bureau property in accordance with manual instructions.

Inspections have been made at many of our projects and district offices, with the result that property accountability and property utilization throughout the Bureau are generally much improved over what they were a year ago. The need for better utilization of the Bureau's automotive equipment has been stressed and considerable progress has been noted in this field of activity. Methods of checking maintenance practices have been studied and preventive maintenance procedures developed that have reduced materially the cost of operating the Bureau's fleet of automotive equipment. A program for the registration and relicensing of all the Bureau's automotive equipment has been undertaken and has been completed. Various activities in the office of the Commissioner located at Denver have been consolidated, with resulting economies and efficiency.



## *Office Services Activities*

A complete review of the Bureau's file manual was undertaken and is practically completed. The revisions of the Bureau's file classification outline have been such that the new activities that have been undertaken in the Bureau, since the original file outline was developed, have been provided for and more detailed instructions included in the file outline to assure more accurate classification of Bureau correspondence at all levels.

During the year plans were developed to establish in Denver a depository for personnel records of all employees that have been separated from the Bureau and for the handling of records of projects that have been turned over to water users or have been abandoned, or otherwise terminated. Approval for the continued operation of the Bureau's regional duplicating plants, including the Bureau's duplicating plant at Denver, was procured from the Joint Committee on Printing.

An arrangement was worked out whereby a large percentage of the Bureau's teletype business is now being handled through the leased lines of the Public Buildings Administration, with substantial savings to the Bureau and with practically no delay in the transmission of our messages through this means of communication.

## REGIONAL REPORTS

### *Region 1*

*Project planning.*—The principal achievement in project planning for fiscal year 1949 was coordination of the Interior Department's report on the comprehensive development of the Columbia River Basin and the so-called "308" Report of the Department of the Army, under an agreement dated April 11, 1949. The coordination included a joint recommendation for the adoption of the power revenue pooling plan proposed in the Interior report and covered such important matters as the division of jurisdiction for the investigations and development of multiplepurpose projects in the Basin.

Related to the work on the Columbia River Basin report were the completion and submittal of seven supplemental reports on projects originally recommended for authorization in the Basin report. These included: Bitterroot Valley project, Montana; Vale project—Bully Creek extension, and Crooked River project, both in Oregon; Upper Star Valley project, Wyoming; Council project, Mountain Home project—Payette division, and Hornet Creek project, all in Idaho. In addition, a report on the North Side pumping division of the Minidoka project was submitted. Other reports completed during the

year included those on the Palisades Dam and Reservoir project, completion of American Falls power plant, and two reports on the rehabilitation of the Ochoco Dam. Three reconnaissance reports were completed and work was underway on two others. Continuing study was made of 2 river-basin surveys and 29 project investigations.

*Construction.*—The Columbia Basin project had \$125,360,000 in construction, supply, and equipment contracts in force—a total unequaled in the history of any Reclamation development. At year's end, irrigation works were approximately 13 percent complete and power installations 65 percent finished. All work on irrigation structures continued to be aimed at the Bureau's goal of having water available for approximately 87,000 acres of land in the spring of 1952.

The Bureau marked "completed" the Long Lake Dam, and the pumping plant and distribution system for the 5,400-acre Pasco unit. On other jobs, the following completion percentages were reached: Grand Coulee Dam pumping plant, 31 percent; feeder canal, 28 percent; north dam, 6 percent; south dam, 98 percent; main canal, 68 percent; east low canal (first section) 95 percent; west canal (first section) 96 percent; Soap Lake siphon (west canal) 5 percent; and O'Sullivan Dam, 99 percent; Burbank unit, 56 percent.

At the Grand Coulee Dam, work pushed ahead on many fronts. Emergency riprapping was started along the banks of the Columbia River below the dam to repair damage wrought by the record-breaking floods of 1948 and to curb possible flood damage in future years.

Construction of Hungry Horse Dam was officially begun on July 10, 1948. The south fork of the Flathead River was diverted and cofferdams sufficiently completed to permit unwatering and starting excavation in the river channel. Clearing of the reservoir area under existing contracts proceeded at good pace. Facilities for showing the project to visitors were also completed and lecture service initiated.

On the Boise project, the construction of the remaining laterals to serve the 25,000-acre pumping unit of the Payette division was under contract, with completion scheduled in time for the 1950 irrigation season. At Cascade Dam, source of water supply for this area and for supplemental service for 83,500 acres in the Emmett Valley, work centered around the relocation of existing properties. Work at Anderson Ranch Dam was confined largely to completion of the spillway, outlet works, and powerplant, all of which are scheduled for completion next summer. Relocation of the Forest Service road and reservoir clearing will be completed early in fiscal year 1950.

The remaining laterals of the Deschutes project system to serve 50,000 acres of new land were completed. Work on Wickiup Dam, major project storage reservoir, was practically finished at the end of the year. Work was begun late in the fiscal year on the rehabilitation of the Ochoco Dam in the Crooked River Basin.

Construction of laterals for the 17 pump areas, embracing 27,000 acres of the 72,000-acre Roza division of the Yakima project was virtually completed. Activities under the rehabilitation program included completion of spillway channel improvements and purchase of spillway gates for Keechelus Dam, opening of bids for the rehabilitation of Tieton Dam and spillway, and opening of bids for rehabilitation of pump discharge and siphon lines for the Prosser irrigation district.

On the Lewiston Orchards project, the pipe distribution systems were brought to approximately 50 percent of completion. Work was started on construction of the water treatment plant. Completion of the project works is scheduled for early in fiscal year 1951.

At Palisades Dam, construction was started on the 51-mile long Palisades-Goshen transmission line. The first pumping plant was placed in operation on one of the test wells of the North Side pumping division of the Minidoka project. Operation of this pump will serve as a pilot installation to determine factors bearing on plans for the irrigation of 64,000 acres by pumping from underground water supplies. Construction was completed on the Locket Gulch wasteway of the north canal on the Owyhee project. On the Hayden Lake Unit of the Rathdrum Prairie project, the pumps were repaired, and 8,500 linear feet of the pump discharge line were reconstructed. A contract was awarded for the reconstruction of the Rock Creek Diversion Dam on the Bitterroot project.

*Power production.*—The output of five Bureau projects in the region rose to a record high of 9.3 billion kilowatt-hours. Gross revenues also reached a new peak, \$9,768,852.

Grand Coulee produced 9.1 billion kilowatt-hours during the year. Its gross revenues were \$9,175,034. The 13,400-kilowatt Minidoka power plant produced approximately 111 million kilowatt-hours, to earn gross revenues of \$437,612. The Boise project, with the 8,000-kilowatt Black Canyon and the 1,500-kilowatt Boise River plants, produced 71.4 million kilowatt-hours and earned \$97,617 in gross revenues. The 2,400-kilowatt Prosser power plant on the Yakima project generated nearly 23.5 million kilowatt-hours to earn \$58,589 in gross revenues.

*Operation and maintenance.*—The 16 projects in the region produced \$202,639,040 worth of crops in 1948 on a cultivated area of 1,910,502 acres, consisting of lands receiving either a full or supplemental supply of water. The total was third highest on record. The previous peak was \$225,235,236, reached in 1947. The 1948 per acre gross return, \$106.07, was second highest of record, being exceeded only by the \$120 per acre gross of 1947.

A total of 1,112 ex-servicemen qualified for the region's lone home-  
stead drawing of the year, held on the Minidoka project on March 3.

Forty-six public land farm units, embracing 4,465 acres on the Hunt unit, were acquired by veterans.

Ten farm units, comprising 846.5 irrigable acres of public land on the Pasco unit of the Columbia Basin project, were sold to as many World War II veterans, the land sold being that purchased by the Bureau from excess landholders. During the next fiscal year, drawings will be held for 48 farm units, involving approximately 4,377.6 irrigable acres on the Payette division of the Boise project, and 11 farm units, aggregating 723.5 irrigable acres on the Roza division.

The Pasco unit of the Columbia Basin project, where 119 acres were irrigated, received water for the first time. Federal irrigation service was extended to the following additional acreages: Boise project (Black Canyon irrigation district, second unit), 1,861 acres; Deschutes project (north unit), 13,200 acres; Minidoka project (Hunt unit), 2,736 acres; Yakima project (Roza division), 6,408 acres; and Rathdrum Prairie project (Post Falls unit), 1,083 acres.

A third "development" farm was put into service on the Columbia Basin project. Working hand-in-hand with the Bureau on this important research program are the Department of Agriculture's Bureau of Plant Industry and Soil Conservation Service, and the Washington State Experiment Station. The Bureau also began studies of sprinkler irrigation on two other areas of the project. Settler assistance programs were inaugurated on the Pasco unit.

Negotiations for new, amendatory supplemental or interim repayment contracts were underway for 27 irrigation districts; namely, the Frenchtown and Bitterroot in Montana; Okanogan, Kittitas, Roza, Prosser, and Sunnyside in Washington; Vale, Arnold, Jefferson (Deschutes), Westland, Stanfield, Hermiston, West Extension, Ochoco, and all seven districts of the Owyhee project in Oregon; and American Falls, Gem (Owyhee), Black Canyon, Hayden Lake, and Riverside in Idaho.

Full agreement on basic principles and terms to be incorporated into amendatory contracts was reached with district boards of the Ochoco, Prosser, Westland, Stanfield, and Vale districts. Interim contracts were executed with the Jefferson water conservancy district, the American Falls Reservoir district No. 2, the Prosser irrigation district, and the Roza irrigation district. A supplemental contract was executed with the Sunnyside irrigation district, and long-range repayment contracts were executed with the Arnold irrigation district, Bitterroot irrigation district, Hayden Lake irrigation district, Kittitas Reclamation district, and the Okanogan irrigation district. Authorization of the North Side pumping division of the Minidoka project and reauthorization of the Palisades project were effected. Extensive programs in the control of weeds on Bureau rights-of-way were carried out.



*Region 2*

*Project planning.*—Major developments in the planning program for the year were the authorization of the Solano County project, California, on January 28, 1949, and the transmittal of the "Comprehensive Plan for Water Resources Development, Central Valley Basin, California" to the President through the Bureau of the Budget on July 29, 1948.

Other significant developments included preparation of a preliminary draft of the report on the "North Fork Kings River Development, Central Valley Basin Plan, California," and the preparation of a supplement to the legislative report on American River development for use in congressional hearings.

Despite limitations upon personnel, the planning program moved steadily forward. Substantial progress was achieved upon the San Luis Obispo, Sacramento River Canals, Trinity River diversion, Feather River, Klamath Basin and Pajaro River investigations.

*Construction.*—Shasta Dam is essentially complete except for miscellaneous minor finish work. Three 110 x 28-foot drum gates were installed during the year, which will provide additional storage of 800,000 acre-feet, bringing total reservoir capacity to 4,500,000 acre-feet.

Three major construction contracts are under way for completion of Keswick Dam and power plant. Construction under these contracts will complete the work delayed during the war. The three 25,000-kilowatt generating units in Keswick power plant will be completed and ready for operation by the end of calendar year 1949.

Two 230-kilovolt west side steel tower transmission lines were completed for a distance of 22 miles from Shasta power plant to a point opposite the PG&E Shasta substation near Cottonwood.

The two principal contracts for construction of the Tracy pumping plant, including the intake canal, and the three 15-foot diameter steel and concrete discharge pipes are approximately 78 percent complete. A contract was awarded in June 1949 for installation of the pumping equipment being manufactured in the east, with completion scheduled for June 1951.

The 120 mile long, 4,600 cubic feet per second Delta-Mendota Canal is approximately 27 percent complete. Work on 43.5 miles of the canal is under way under three major construction contracts. Construction for a distance of 23.2 miles has been completed.

Friant Dam and Reservoir are essentially complete except for minor finish work. Removal of the two temporary needle valves borrowed from Hoover Dam during the war and the installation of four permanent 96-inch hollow jet valves in the river outlet section and also

four 96-inch hollow jet valves in the Friant-Kern Canal outlet section is nearing completion.

The 153 mile long, 4,500 cubic feet per second Friant-Kern Canal is approximately 62 percent complete. The first 75-mile section to Kaweah River is complete and was put into interim operation on July 9, 1949.

Start of construction work on the Santa Barbara project has been temporarily deferred pending execution of a water-service contract and completion of other preliminary work.

*Power production.*—Shasta power plant was essentially completed with the fourth unit going in service in July 1948 and the fifth and final in April 1949. The first segment of west side line No. 2 from the Shasta power plant to the vicinity of the Pacific Gas & Electric Co. substation, with an emergency tap to the substation was energized.

Fiscal year 1949 showed the greatest generation and greatest revenue thus far from Shasta power plant. Energy sales were 1,681,760,468 kilowatt-hours and annual revenue was \$6,523,225.22; this figure being almost double that for fiscal year 1948. On December 31, the contract with the Pacific Gas & Electric Co., which had been in existence since 1944, expired. The company continued its policy of refusing to furnish electricity on a conveyance or exchange basis other than for Central Valley project pumping use. Because Shasta power was vitally necessary to the economy of the State, on January 1, 1949, the Bureau entered into a written agreement with the Company which provides that the capacity and energy which the Bureau may declare available for disposition to the company on any day shall be announced to the company on or before the day previous, and the company shall be obliged to take and pay, or pay, for all capacity and energy so declared available.

Hearings on the formal complaint by the United States against the Pacific Gas & Electric Co. before the California Public Utility Commission, seeking to establish a class of service and a rate for the exchange or conveyance of public power over intervening private utility transmission systems were concluded in December 1948. The Commission had not rendered its decision at the close of the fiscal year.

A number of conferences were held with representatives of industrial concerns regarding the availability of power capacity from Shasta power plant.

*Operation and maintenance.*—Operating the Central Valley project during the fiscal year 1949 involved the handling of 4,425,980 acre-feet of inflow to Shasta Lake and 1,236,710 acre-feet of inflow to Millerton Lake. The multiple purposes of Shasta Lake were served by releasing 4,368,250 acre-feet of water, all of which passed through the Shasta power plant. Of the water handled in Millerton Lake,

100,560 acre-feet were diverted to the Madera Canal, 3,000 to the Friant-Kern Canal, and 1,178,670 were released through the river outlet valves for the downstream users. Diversions by the Contra Costa Canal system to supply industrial, municipal, and irrigation requirements totaled 18,640 acre-feet. Total revenues from sale of agricultural water for irrigation of 250,000 acres and from municipal and industrial water sales are estimated at \$700,000.

Land classification activities during fiscal year 1949 included completion of mapping on approximately 204,000 acres of land, 36,000 acres of land were mapped in detail and semidetall surveys were made on 168,000 acres.

The Annual Crop and Livestock Census for Klamath, Orland, and the Central Valley projects was completed. Crop returns from the total irrigated area of 390,000 acres were: Klamath, \$17,540,000; Orland, \$1,410,000; and Central Valley project, \$31,200,000. The regional total of \$50,150,000 was \$6,600,000 less than the figure for the preceding year. Average crop value declined from \$149 to \$129 per acre.

Public Notice No. 47, dated August 27, 1948, opening 8,283 acres in 86 units, located in parts 1 and 2 of Tule Lake division, Klamath project, was prepared and issued. The drawing for the 86 units was held on February 23, 1949. A total of 258 candidates and alternates were selected.

On the Central Valley project, contract negotiations were carried to completion and contracts executed with the Lindsay-Strathmore, Lindmore, and Orange Cove irrigation districts, and the Shasta Dam area and Summit City public utility districts.

### *Region 3*

*Project planning.*—Congressional committees considered bills to authorize the Central Arizona project. Project planning investigations of several years culminated in the near-completion of reports on the Dixie and Santa Margarita projects. The Moapa Valley investigation is advanced so that conclusions can soon be drawn. Region 3 field forces, cooperating with region 4, completed a major part of the investigations of the preferred dam site in Glen Canyon on the Colorado River just above Lee's Ferry.

Approval of legislation authorizing delivery of water to the Yuma Auxiliary project through the Gila project works was obtained. Negotiations with the North Gila Valley irrigation district for delivery of water to district lands in the North Gila Valley were continued. Intensive investigations of sprinkler irrigation possibilities on the Yuma Mesa division of the Gila project were undertaken. A rehabilitation survey on the Valley division of the Yuma project was com-

pleted and work initiated under the water users' annual budget. Rock was placed in Palo Verde Temporary weir intermittently as required. Field work on the Lake Mead sedimentation survey was completed and a preliminary survey of necessary levee improvements in the Yuma area made.

*Construction.*—The construction and planning programs throughout the region moved forward with these high lights: (1) completion of the Davis Dam embankment; (2) completion of portions of the major Davis transmission system features; (3) turning over of Coachella Canal to water users; (4) construction progress on Coachella distribution system; (5) opening of bids for initial construction on the Wellton-Mohawk Canal; (6) beginning of dredging on the Colorado River; (7) settlement of homesteaders on Gila project; (8) consideration by the Congress of the Central Arizona project; (9) ordering of two main generating units for the Hoover power plant.

Late in June 1949 bids were opened for the construction of the first 8½ miles of the Wellton-Mohawk Canal on the Gila project. The contract was awarded the Fisher Contracting Co. of Phoenix, Ariz., at a price of \$1,335,463.70. Contracts were awarded earlier in the year for pumps and motors for each of the three pumping plants to be built on the canal.

Contracts were awarded for generating units A-3 and A-4, each of 82,500-kilovolt-amperes rating. The units will be installed in the Hoover power plant to supply Arizona's allotment of Hoover energy. The site for the new 230-kilovolt States' switchyard at Hoover Dam was selected and design work started.

The State of Nevada requested the installation of a 62,500-kilovolt-ampere unit in the Hoover power plant to make available to Nevada a portion of its allocation of Hoover energy. Specifications for this unit were issued.

Some 4 million cubic yards of earth and rock had been placed in the Davis Dam embankment up to the close of the year to bring that feature of the project to completion. Powerhouse foundation concrete was placed and the five turbines and generators were delivered and are awaiting installation. The second Phoenix-Tucson 115-kilovolt transmission line, the third synchronous condenser at Phoenix, and the second Gila-Yuma 34.5 kilovolt transmission line were completed and placed in operation.

*Power production.*—Hoover, Parker, and Siphon Drop power plants generated over 6½ billion kilowatt-hours, exceeding the previous year's output by about 5.7 percent and coming within 8 percent of the 1944 record. These plants accounted for more than a third of the power produced at all Reclamation projects and furnished nearly 42 percent of the total power consumed in the region. All water released from



Hoover and Parker Dam, except 240,000 acre-feet bypassed at Parker Dam for flood control purposes, was utilized for power production.

*Operation and maintenance.*—Farmers grossed \$153,110,228 on 787,565 acres irrigated by Reclamation facilities for a per acre value of over \$194. This was a 13 percent increase over the 1947 crop income. Operation and maintenance of the Coachella Main Canal, below Station 2604, was assumed by the Coachella Valley County water district on March 25, 1949. With construction pushed on the first six of the ultimate nine units of the 76,000-acre concrete-pipe water distribution system for the Coachella Valley, irrigation deliveries were begun through the laterals as they were completed.

Approximately  $1\frac{1}{4}$  miles of main channel were dredged between Needles and Topock by the Bureau's new Colorado River 20-inch hydraulic suction dredge, placed in operation on January 31. More than a million cubic yards of river-bottom material were removed.

Fifty-four farms on the Yuma Mesa division of the Gila project, ranging in size from 40 to 160 acres and comprising 4,940 acres, were settled by war veterans. Plans were initiated for the opening of additional public land in the Gila and Coachella Valleys. The Secretary advised the Imperial irrigation district that the public lands on Imperial East Mesa under the All-American Canal system were not practicable of irrigation and would not be opened for homestead entry under Reclamation law.

### Region 4

*Project planning.*—Eight project planning reports, including emergency production of a report enabling authorization by the Eighty-first Congress of the \$69,500,000 Weber Basin project, were issued.

Ratification by the Congress of the Upper Colorado River Compact early in 1949 eliminated uncertainty concerning water rights and cleared the way for an extensive program of water-resources development in the Upper Colorado River Basin. Since the compact terms became known the general plan of development as outlined in "The Colorado River," prepared in 1946 and printed as House Document No. 419, has been refined and amplified under the Colorado River storage project investigation. A preliminary report was prepared, tentatively outlining a desirable combination of reservoirs and an operation schedule to provide the greatest over-all benefits in river regulation, irrigation, power production, flood and silt control, and recreation. Detailed investigations were completed at the Glen Canyon storage site on the Colorado River and at the Echo Park site on the Green River, with investigations under way on other sites for the nine principal multiple-purpose reservoirs described in the report. The project plan provides for financial assistance to other irrigation

projects that meet certain criteria. Power revenues not required to pay the cost of power-plant construction would aid the participating projects. It is essential that the incidental hydroelectric power production from all potential main-stem plants would total more than 9 billion kilowatt-hours annually. Potential participating projects for which preliminary reports were prepared during the fiscal year include the Collbran and Florida in Colorado, the Pine River extension in New Mexico and Colorado, and the Seedskaadee, Eden, and Lyman in Wyoming. Other potential participating projects on which reports were nearly completed include the LaPlata, Smith Fork, and Silt in Colorado; the Central Utah in Utah; the LaBarge in Wyoming.

The Weber Basin project report, on which congressional authorization in August 1949 was based, outlined a plan for the full use of remaining undeveloped water in the river system. It, together with the Bear River project and the Central Utah project, comprises the principal plans for basin-wide development described in the Bonneville Basin report, completely revised and rewritten during the year. Formulation of a definite plan of development on the Bear River was retarded by disagreement among the States of Utah, Wyoming, and Idaho concerning division of water.

Investigation work in the Lahontan Basin was confined largely to a study of the existing Newlands and Humboldt projects. Further planning work on the Truckee and Carson Rivers awaits completion of the Newlands project studies.

*Construction.*—Approximately \$6,000,000 of a \$7,500,000 scheduled program was accomplished; rejection of bids received early in August for the construction of Duchesne Tunnel, Provo River project, Utah, and the Spring Creek Dam, Paonia project, Colorado, accounting for the carry-over. Despite unusually severe winter weather other construction was carried out as programed. The region's seventeenth dam, on the Mancos project, Colorado, was completed.

Seven sets of specifications were issued for canals and structures, small reservoirs, pipe lines, and a tunnel as result of delegations from the Chief Engineer to expedite preparation of designs.

A major contract awarded in August provided for completion of the 41.7-mile Salt Lake aqueduct, Provo River project, Utah. Completion of the Jordan Narrows siphon and pumping plant in May 1949 enabled delivery of water to west Salt Lake Valley lands heretofore dry farmed. Jackson Gulch Dam and inlet and outlet canals, Mancos project, Colorado, were completed by contract in December 1948, more than 18 months ahead of schedule. The Preston Bench project, Idaho, was started from preconstruction and pushed practically to completion within the year through cooperation of the water users, project

personnel, and the contractors. The Congress, on June 28, 1949, reauthorized construction of the Eden project in southwestern Wyoming.

*Operation and maintenance.*—Completion of Jackson Gulch Dam increased the number of reservoirs in the region to 17. Operation and maintenance of the Gravity division of the Grand Valley project, Colorado, and of the Scofield project, Utah, was transferred to the water users organization on January 1 and April 1, 1949, respectively. Reduced yields and lower prices decreased gross crop values to \$37,056,326 from 536,325 acres, off \$7,697,000 from the record high 1947 crop returns. Water supplies varied from fair to excellent, Nevada's being the most unfavorable.

Pursuant to Public Law 462, amendatory contracts were completed with the water users of the Provo River project, Utah, permitting the rental of project water and works on a year-to-year basis until costs in excess of existing contract obligations have been paid to the Government, rates to be fixed by the Secretary. An amendatory repayment contract with the Uncompahgre Water Users Association was completed in accordance with Public Law 56 authorized by the Eighty-first Congress. A supplemental contract with the South Ogden conservation district, Ogden River project, Utah, was also completed, as was a report on the Humboldt project outlining a plan for alleviating drainage and flood control problems on the project.

### *Region 5*

*Project planning.*—Investigations were completed and final drafts of feasibility reports on the Vermejo, New Mexico, and Big Creek, Texas, projects were transmitted to the Commissioner's office. The preliminary draft of a report on the Canadian River project, Texas, was also forwarded to the Commissioner. Investigations of the authorized Valley Gravity project, Texas, and a report thereon seeking amended authorization of the project were completed. Program reports on the Robert Lee, Texas, and the Balmorhea, Texas, projects were completed. A feasibility report on the Canton project, Oklahoma, for irrigation development was completed and transmitted to the Commissioner, but the report was returned for consideration of facilities to provide a municipal water supply for the city of Enid, Okla. Studies of the San Juan-Chama project, Colorado and New Mexico, and field work on comprehensive inventories of land and water resources in the Red and Arkansas River Basins and Gulf Basin were continued during the year.

*Construction.*—Construction work was in progress on four projects. On the W. C. Austin project, the radial gates on the controlled spillway and operating bridge across the dam were installed, thus complet-



ing the dam. Construction was completed on the last portion of the lateral system in October 1948. Work was performed in connection with a contract awarded in February 1949 for the construction of a portion of the drainage system. On the Rio Grande project, construction work was completed or well advanced on the following items: paving camp roads at Elephant Butte; Socorro and Alamogordo substation structures; residence at Alamogordo substation, and fencing of Caballo Dam outlet works. On the San Luis Valley project, notice to proceed with work was issued in June 1949 for the construction of Platoro Dam, and actual construction was initiated. On the Tucumcari project, the construction of canals and laterals was continued so that facilities serving unit No. 6 were almost complete and facilities serving unit No. 7, the last unit, were well on the way toward completion. Construction work was completed on the riprap for laterals and five ditch-rider residences with facilities. On the Carlsbad project, work was completed in connection with the drilling of blasting holes in the compacted earth filled embankment of Alamogordo Dam for the emergency flood plan.

*Power production.*—A part of the Rio Grande project, the hydro-generating plant at the top of Elephant Butte Dam, consisting of three 8,100-kilowatt generating units, and a transmission system from this plant, constitutes the existing power facilities in region 5. Total energy sold in fiscal year 1949 was 74,891,173 kilowatt-hours, which produced a revenue of \$388,524.02. Generation was below normal due to the low water conditions in Elephant Butte Reservoir. Proposed additions to the Rio Grande transmission system in the near future are a 72-mile, 115 kilovolt transmission line from Socorro to Albuquerque with a substation at Albuquerque, and a 50-mile, 115 kilovolt tap transmission line from Bernardo to Willard with a substation at Willard.

*Operation and maintenance.*—The operation and maintenance activities involved two projects in full operation, two in partial operation, and one water conservation and utilization project in full operation, and one Warren Act contractor. On these projects about 233,681 acres in 8,704 farms supporting a population of 49,892 were irrigated in 1948. Total gross crop income was \$52,563,573.

On the Rio Grande project, the 155,715 acres irrigated in 1948 produced a total crop value of \$42,820,056 or \$273.70 per cropped acre. On the Hudspeth project, water being delivered under a Warren Act contract, 17,153 acres produced a total crop value of \$3,997,381 or \$233.04 per cropped acre. On the Carlsbad project, the 20,167 acres irrigated in 1948 produced a total crop value of \$2,727,119 or \$135.23 per cropped acre. On the W. C. Austin project, the 17,433 acres irrigated in 1948 produced a total crop value of \$1,558,691 or \$89.41 per cropped acre. Irrigation facilities are now complete to



serve all of the project's 49,972 irrigable acres. On the Tucumcari project, the 16,069 acres irrigated in 1948 produced a total crop value of \$777,572 or \$48.39 per cropped acre. As of June 30, 1949, facilities were complete to serve about 29,000 acres of the project. On the Balmorhea project, about 7,570 acre-feet of water was delivered from the Bureau-owned Phantom Lake Spring. The 7,144 acres irrigated in 1948 produced a total crop value of \$682,704 or \$95.56 per cropped acre. The soil and moisture conservation program for fiscal year 1949 included: the construction of five detention dams and 5,600 lineal feet of diversion terraces on the Lake Altus Reservation, W. C. Austin project; and salt cedar spraying and mechanical clearing and a channelization work for water conservation in McMillan Reservoir delta and inflow area, Carlsbad project.

Repayment contracts on the Fort Sumner project and Platoro unit of the San Luis Valley project were negotiated; negotiations were continued with the cities of El Paso and Tucumcari for water supplies from project sources; and contracts on the Tucumcari project for the sale of water under the Warren Act were negotiated.

### *Region 6*

*Project planning.*—Investigations to obtain material for basin reports were carried forward on 20 basins and divisions. Preconstruction work necessary to ready units for construction progressed on 31 units. At the close of the year, detailed unit reports were complete on the Cartwright, Lower Marias, Owl Creek, N-Bar-N, and Fort Clark units.

*Construction.*—Despite some continued shortage of materials and, in some cases, a shortage of labor, the construction program in the region made excellent progress. The following construction contracts were completed: Clearing of reservoir area for Angostura unit; camp buildings and access road for Bixby unit; camp buildings for Boysen unit; road relocation and camp facilities for Canyon Ferry unit; camp facilities and transmission line relocation for Heart Butte unit; prefabricated buildings for Keyhole unit; camp buildings for Moorhead unit; camp facilities for Shadehill unit; Lost Wells lateral system, portion of Wyoming Canal, most of the North Pavillion lateral system, and Pilot Canal laterals for Riverton project; Heart Mountain Canal and laterals, Ralston laterals, concrete chute on Willwood Canal, Heart Mountain power plant and Heart Mountain-Garland transmission lines for Shoshone project.

Satisfactory progress was maintained on those contracts continued from fiscal year 1948 which will not be completed until after fiscal year 1949. Among these construction jobs are Angostura Dam where

the contract is 86.2 percent complete despite delays caused by flash floods on the Cheyenne River; the Boysen Dam, power plant and railroad relocation where operations were handicapped by uncertainties as to appropriations, by unusually difficult geological conditions in the railroad tunnel, and by the destruction of the contractor's concrete batching plant by fire; the Heart Butte Dam; canal and lateral work at Riverton; and the Glendive-Miles City and Fort Peck-Garrison transmission lines.

New construction contracts totaling \$20,722,159 were awarded on Dickinson, Shadell, and Canyon Ferry Dams; the Savage pumping plant, canals and laterals; the Watford City, Wolf Point, and Savage substations; groundwires for the Glendive-Miles City transmission line; Heart Butte reservoir clearing; access road for Bixby Dam; relocation of county road approaches to Canyon Ferry Dam; relocation of Fort Peck-Rainbow transmission line; canals and laterals at Riverton; camp facilities for Keyhole, Shadell, and Moorhead Dams; and housing facilities at Fort Peck. Additional contracts for major equipment totaling \$1,184,430 were also awarded as follows: Power-plant transformers, tunnel ventilating equipment, radial gates, circuit breakers and switches for switchyard, penstocks and outlet pipe for the Boysen Dam and power plant; penstocks for Canyon Ferry Dam and power plant; equipment for the Thermopolis, Miles City, Forsyth, and Sidney substations; carrier current telephone apparatus; steel structures for the Williston-Garrison transmission line; and new gates and hoists for the Belle Fourche Dam.

Most contractors have made satisfactory starts on those major contracts let in fiscal year 1949. Labor and materials are becoming more readily available and the period of rising construction costs seems to have ended.

Planned construction on several major jobs did not get under way. The issuance of specifications on Anchor Dam was held up pending clearance of water-right questions on the unit. Issuance of construction specifications for Tiber Dam was delayed pending determination of the attitude of the landowners relative to repayment of irrigation costs. Designs for Cannonball Dam were delayed pending further study of the land available for irrigation so that designs can be drawn for the correct storage capacity. Design work for Bixby Dam was stopped to permit a more thorough analysis of the quality of the water to be impounded for irrigation. Additional design data required for Keyhole Dam and studies of alternate plans delayed the issuance of construction specifications.

*Power production.*—The addition of a second generating unit of 15,000-kilowatt rated capacity at Fort Peck late in fiscal year 1948

and the completion of the 5,000-kilowatt Heart Mountain power plant early in December increased the generation of Federal hydroelectric power plants in the region, for which the Bureau markets the power, from 294 million in fiscal year 1948 to 446.7 million kilowatt-hours in fiscal year 1949. Over 220 million kilowatt-hours of this energy was delivered to the Montana Power Co. for ultimate use in meeting the critical power shortage in the Pacific Northwest. Five new REA co-operatives were given service, bringing the total served by the Bureau in this region to 22.

*Operation and maintenance.*—The 11 operating irrigation projects in the region produced a gross crop value of \$18,161,000 during calendar year 1948. One hundred and four units, comprising 12,073 acres of irrigable public land, were opened to settlement on April 13 under Public Notice No. 58 on the Heart Mountain division of the Shoshone project. Public Notice No. 28, Riverton project, was issued May 4 and opened to settlement 50 units, comprising 5,912 acres.

Drafts of amendatory repayment contracts were prepared for the Deaver irrigation district (Departmental approval received February 28 and water users' approval April 9); the Belle Fourche irrigation district (Departmental approval received April 4 and water users' approval May 3); the Midvale irrigation district; the Lower Yellowstone irrigation district No. 1; the Lower Yellowstone irrigation district No. 2; and the Huntley irrigation district. Drafts of repayment contracts were prepared for the Heart River irrigation district (Departmental approval received May 3); the Willwood irrigation district (Departmental approval received October 22, water users' approval December 18, and authorization for execution by the United States by act of Congress of May 6); the Buffalo Rapids irrigation district No. 1 and Buffalo Rapids irrigation No. 2; the Malta irrigation district and the Glasgow irrigation district; and the Buford-Trenton irrigation district. The repayment contract with the Savage irrigation district was executed in behalf of the United States on December 10.

Contracts for the repayment of rehabilitation and betterment work were prepared for, and execution secured by, the Malta, Harlem, Paradise Valley, Alfalfa Valley, Zurich, and Fort Belknap irrigation districts of the Milk River project; the Willwood irrigation district of the Shoshone project; and the Fort Shaw irrigation district of the Sun River project. Resolutions were secured from the Belle Fourche irrigation district of the Belle Fourche project and from the Midvale irrigation district of the Riverton project. By the spring of 1949, a total of five development farms were in operation in Montana, North Dakota, and South Dakota.

*Region 7*

*Project planning.*—Investigation reports have been coordinated by the region to allow the maximum efficiency in the preparation of the various basin reports. During the year the Lower Platte River Basin report and interim reports for the Blue-South Platte and Gunnison-Arkansas project were completed, reproduced and submitted to all interested State and Federal Government agencies for their review and comments. The two projects, dependent upon transmountain diversion of Colorado River water, will depend for completion of the reports and subsequent construction on the division of water made available under the Colorado River Basin Compact between the eastern and western slopes. Construction of the project facilities will tend to solve the problem posed by irrigation and municipal water deficiencies in Colorado east of the Rockies, provide generation of a large block of sorely needed hydroelectric power as well as flood control and sedimentation benefits.

Work was initiated on the Kansas River Basin report which consists of combining reports already under way on the Republican River and Smoky Hill River Basins together with additional studies on the Blue River and the lower Kansas River area. Water supply studies were revised in compliance with restrictions of the Republican River compact.

Land classification of project lands was continued to bring data up-to-date and to provide a more detailed basis for specific units. In this connection, contracts have been made with various State educational institutions to provide much of the technical personnel in making the various classifications desired. Additional topographic surveys and drilling to determine character of subsurface formation have been made at various dam sites, reservoir areas and along the expected reaches of canal lines.

Assistance was given to local interests in the promotion and formation of irrigation districts in all parts of the region, that in the end, repayment contracts might be more easily executed.

Work continues on the Niobrara, North Platte and South Platte comprehensive plan investigations with the objective of completing basin inventory reports.

*Construction.*—Construction activities were carried forward in all parts of the region. On the Mirage Flats project only a small amount of force account work remained which will be completed prior to transfer of the project to an operation and maintenance status. On the Colorado-Big Thompson project, 21 construction contracts were in force totaling \$35,000,000. Work was completed on the Aspen Creek siphon and Prospect Mountain conduit, four tunnels of the Horsetooth feeder canal, and two of the four dams of the Horsetooth



Reservoir; construction was virtually complete on Olympus Dam and the other two dams of the Horsetooth Reservoir, and was well advanced on Granby Dam, pump plant and canal, and Marys Lake and Estes power plants. During the year new contracts were awarded on the canal portion of the Horsetooth feeder canal, on four transmission lines and two substations. The project is approximately 50 percent complete.

Construction of the vast Missouri River Basin project has progressed rapidly since May 1946 when the first blast was set off to start clearing of the Kortes Dam site. At the beginning of the year contractors were busy on the Kortes Dam in Wyoming; on Enders and Medicine Creek Dams, the Cambridge Diversion Dam, and Cambridge Canal of the Frenchman-Cambridge division in Nebraska; on four transmission lines in Nebraska and Wyoming and on housing units for the Narrows, Cedar Bluff, and St. Francis units. During the year the housing units, three of the transmission lines and the diversion dam were completed, concrete placement was well under way at Kortes, the earth fill for Enders and Medicine Creek Dams was fast taking shape, and the first section of the Cambridge Canal was 67 percent complete. New work started on the project included Bonny and Cedar Bluff Dams, Superior Courtland Diversion Dam, the Superior Canal, two large transmission lines, and two substations.

In addition to the construction activities which were under actual construction, several features were under invitation to bids, for which awards would be made immediately after the end of the year. These include the Pole Hill and Olympus Tunnels on the Colorado-Big Thompson project, Trenton Dam of the Frenchman-Cambridge division, and the Courtland Canal of the Bostwick division.

While most construction projects showed reasonably good progress, others were unable to proceed with scheduled operations because of difficulties beyond their control. The Glendo and Narrows units, scheduled for a start of construction in the spring of 1949 are further delayed until the spring of 1950 and 1951, respectively, because of the uncertain support of State groups over the amount of water available for the reservoirs. The Courtland Canal, Republic Diversion Dam, and other features on the Bostwick division did not reach the design stage because of questions raised on the legality of the present Kansas irrigation laws.

*Power production.*—The power activities of the region have consisted of the operation and maintenance of the Seminole, Guernsey, and Lingle power plants in the North Platte River district, and the Green Mountain Dam in the South Platte River district.

The four hydroelectric plants in the region generated 261 million kilowatt-hours of electrical energy, 259 million kilowatt-hours of

which were sold to municipalities, REA cooperatives, industrial plants, and public utilities for a gross revenue of \$1,713,436.

The outstanding problem the region is confronted with at this time is the rapid rate of load growth to be cared for by the existing power plants. Little relief can be expected until May 1950 when two units of the Kortess power plant with 24,000 kilowatts installed capacity will be put into operation. The Estes power plant with its 45,000 kilowatts installed capacity and the Marys Lake with 8,000 kilowatts are scheduled for completion about August 1950, and the third unit at Kortess in October 1950.

*Operation and maintenance.*—No group of new facilities were completed on the various projects within the region that would allow irrigation of additional acreages. However, preparation of farm units in the Mirage Flats project allowed the distribution of water to the full 12,000 acres of the project and on the Kendrick project, 2,000 additional acres were placed under irrigation, making a total of 6,000 acres.

At the close of the fiscal year, irrigation in region 7 reached a total of 220,000 acres. Approximately 200,000 acres were irrigated on the Bureau's North Platte project in Wyoming and Nebraska, 6,000 on the Kendrick in Wyoming, 12,000 on the Mirage Flats project and 2,000 on the Frenchman-Cambridge division of the Missouri River Basin project in Nebraska. In addition, supplemental water was delivered to 30,000 acres of the Northern Colorado conservancy district lands and to 110,000 acres of Warren Act lands in the North Platte project.



